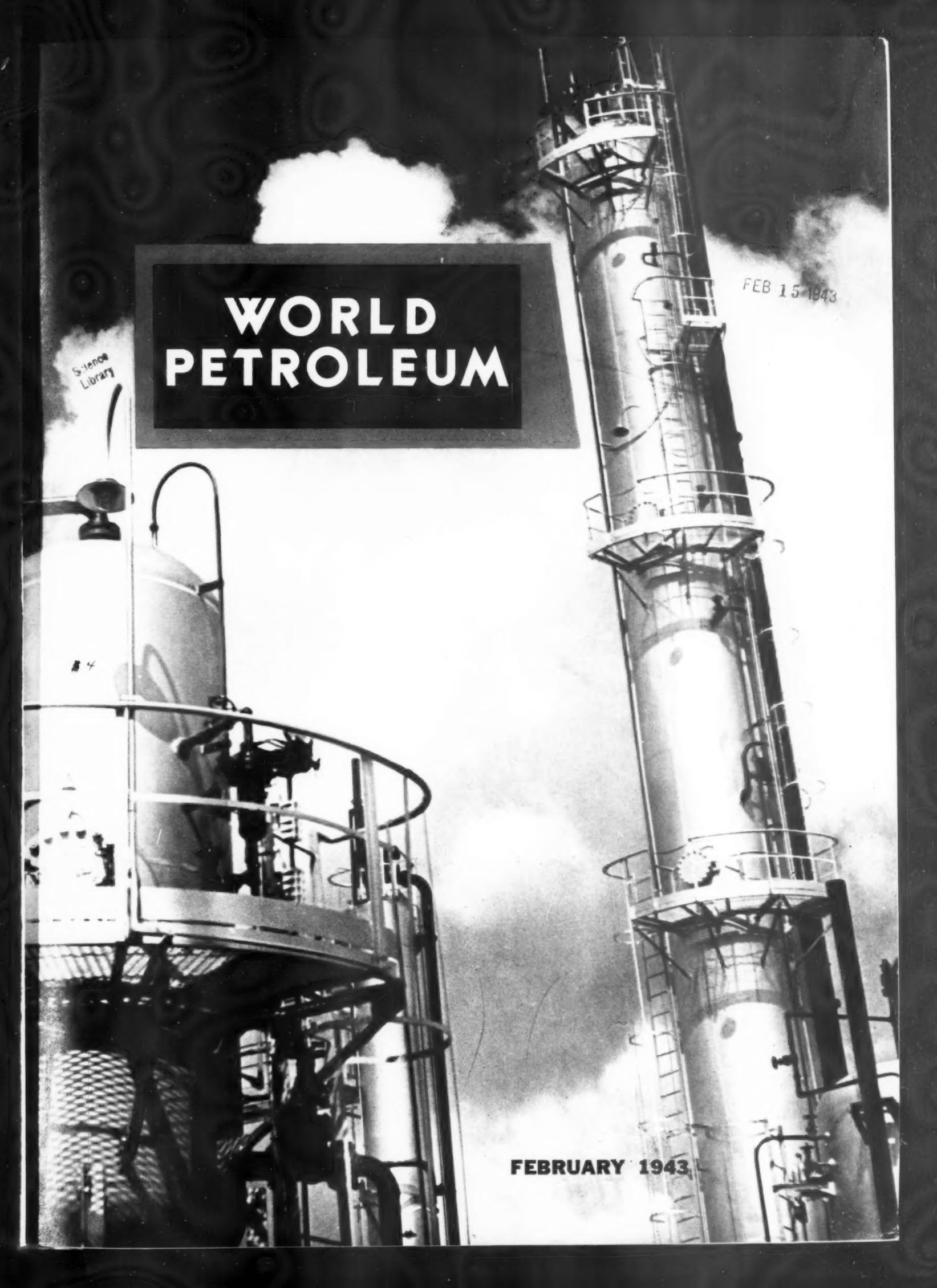


WORLD PETROLEUM

FEB 15 1943
Science Library

FEBRUARY 1943

*One of the typical shots fired in S S C's world wide search for petroleum.

Miniature*EARTHQUAKES in America are Finding the Oil—

that the Armed Forces of the Allies are Using to BLAST the Axis

★

The explosion of a 600 pound bomb dropped from an airplane.

Photograph: Underwood & Underwood, U. S. Army.

Seismograph Service Corporation

CONSULTING EXPLORATION GEOPHYSICISTS

Kennedy Building . . . . Tulsa, Oklahoma, U. S. A.

WORLD PETROLEUM

Incorporating Petroleum Equipment Exporter

THE MANAGEMENT PUBLICATION OF THE INTERNATIONAL PETROLEUM INDUSTRY

VOLUME 14 | FEBRUARY, 1943 | NUMBER 2

CONTENTS

Problems of War Production 21

Jersey Standard's New Bayway Plant . 22

Petroleum and War 25

Price and Oil Industry's Progress . . . 28

New Houdry Process 33

Diversion of Materials Threatens Rubber Program 34

Statistical Data 38

Dogs of War 40

Patents and Research 43

Wood River Refinery Receives "E" . . 46

Foreign Oil Legion 48

Abstracts 50

Rex W. Wadman
General Manager

E. W. Mayo
Editor

Victor N. Raiser
Advertising Manager

Jack Seiden
Art Director

SUBSCRIPTIONS

Annual subscription is offered at the flat rate of $5.00 (U.S.) postpaid. Single copies are obtainable at 50 cents

CORRESPONDENCE

Address all correspondence regarding editorial, advertising and subscription matters to 2 West 45th Street, New York. Telephone: Murray Hill 2-7333.

Published monthly by the estate of Russell Palmer, 34 Crystal Street, East Stroudsburg, Pa.

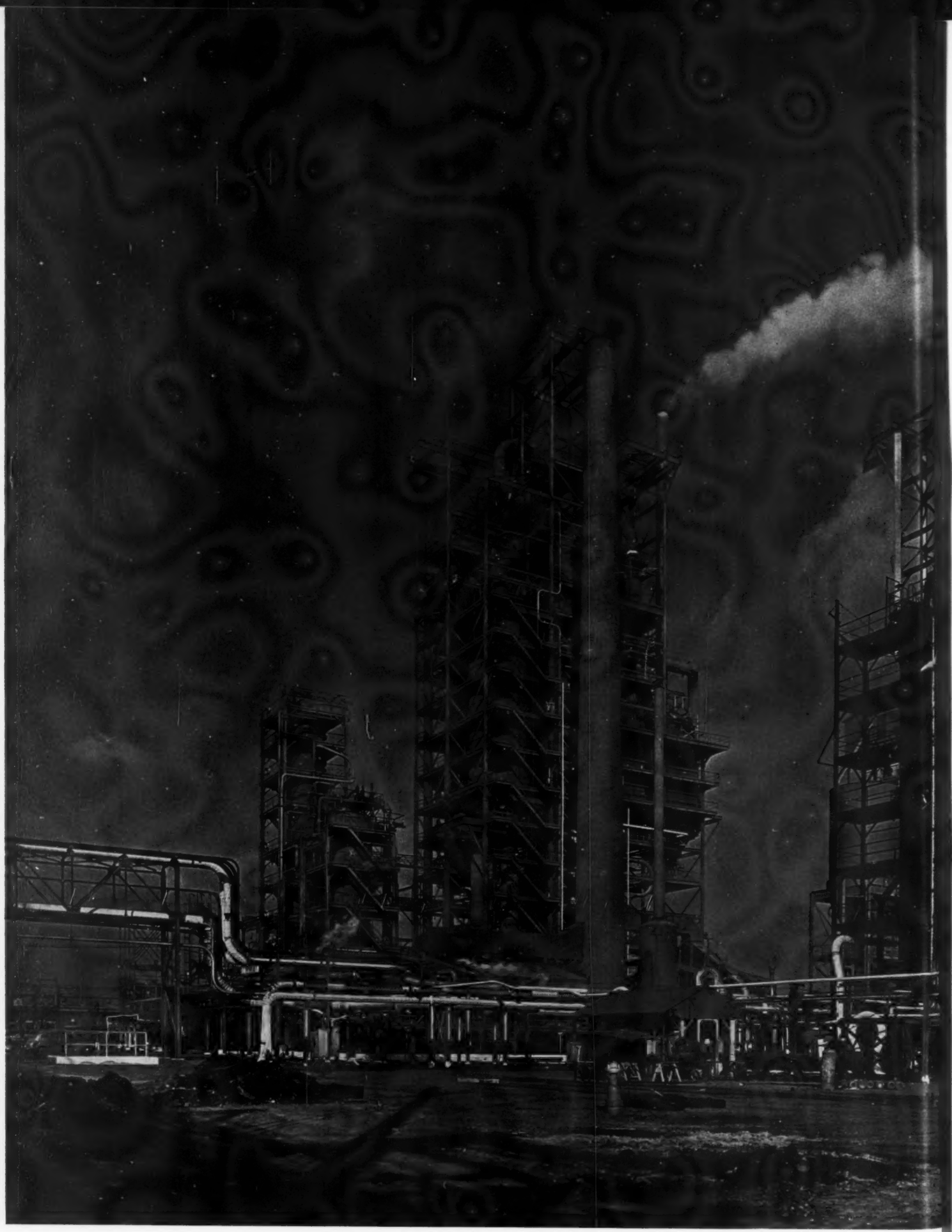
London office: Brettenham House, Lancaster Place, W.C.2.

Pacific Coast Advertising Manager: Don F. Harner, 1595 Pacific Avenue, Long Beach, California. (Tel.: 613-238)

Mid-Continent Advertising Manager: O. F. Cozier, 2216 East 19th Street, Tulsa, Oklahoma. (Tel.: 6-9623)

Mid-West Advertising Manager: Willard R. Cotton, 307 North Michigan Avenue, Chicago, Illinois. (Tel.: Franklin 2508).

Michigan Manager: R. F. Pickrell, 314 Stephenson Bldg., Detroit, Michigan. (Trinity 1-0790).



New catalytic cracking plant of the Standard Oil Company of New Jersey at its Bayway refinery.

EDITORIAL

SHIFTING PROBLEMS OF WAR PRODUCTION

IN all-out war such as now rages around the world five factors are of vital importance. These five are food, fuel, transportation, armament — and men. Upon the mobilization of these elements in correct proportions depends the ability of any nation, large or small, to wage war successfully. The highest strategy is that which brings to bear against the enemy the strongest force that can be trained, equipped, moved and supported at maximum efficiency. The task is one of enormous difficulty and perfect attainment is practically impossible in a conflict like the present one spread over an area as vast as the globe itself and conducted under conditions subject to swift and sweeping changes.

No scheme of production encompassing all the manifold requirements of this titanic struggle formulated at its commencement could have withstood the necessity of frequent revision as the tides of war ebbed or flowed in one quarter or another; as unforeseen pressures or weaknesses developed, compelling the concentration of attention upon some one particular phase of activity even at the expense of effort in other scarcely less essential lines of endeavor. The most obvious criticism of the American war effort is that it has perhaps undertaken too much in too many different directions and that it is not so organized that it can be quickly adjusted to changes that may be needed. In the multitude of little czars who throng Washington, each intent — and properly so — upon the accomplishment of his assigned task there is no one whose sole business it is to see the picture in full perspective and with authority to make changes as swiftly as changing conditions demand, and with no other standard of guidance than the imperative necessity of winning the war and winning it in the shortest possible time. Such authority resides of course in the President but his attention must be directed to many other subjects — to the political strategy of the war, relations with allied nations and the conduct of the greatest business enterprise on earth, the government of the United States. It would be impossible for any one human being to handle all these matters plus the management of a world wide war.

The matter is one of serious importance because of the widespread impression which unquestionably prevails that the war production program, viewed from the broad angle of including everything needed for prosecution of the war, is out of balance in certain respects. The fact is of course that it tends continually to get out of balance and that the important consideration is to correct the inequalities before the imbalance becomes too serious. That there are disagreements among divisional organizations as to the relative urgency of different lines of war activity is not to be denied. It must be remembered however that the executive heads of these departments have a special responsibility to those they represent. Certainly nobody could expect the procurement officers of the Army and Navy to admit or to believe that any other needs could supersede those of their respective Services. Similarly those who are charged with transportation of war materials would hardly be fit for their positions if they did not give first importance to the movement of these supplies to the places where they are needed. The real competition is one involving the most effective use of materials, not the jurisdiction or authority of individuals.

A case in point is the discussion that has been going on recently as to possible deferment of a part of the synthetic rubber program along with some other lines of war production activity in order to release more materials for shipbuilding. Mr. Jeffers was appointed to perform a specific task, the carrying out of a program for supplying the country with its full requirements of rubber. Quite properly he insists that if this program is to be delayed by failure to deliver on schedule the materials needed for the construction of approved plants the responsibility for such action shall be definitely placed. Meanwhile the country is being told by those who assume to speak with knowledge that the Number One necessity of the time is for ships, more and more ships of many kinds, but especially for ships to combat enemy submarines and to provide protection for transports and cargo vessels carrying men and supplies across the ocean. Decision to provide immediate clearance for only 43.5 percent of the materials of construction for butadiene plants presumably has been dictated by military necessity and must be so understood.

Occurrences such as these are of deepest significance to the national welfare but they have a special importance also for the petroleum industry. Inasmuch as oil is involved in almost every phase of the war effort difficulties and delays in the rubber program like the mistakes in gasoline and fuel oil rationing are likely sooner or later to be laid at the industry's door in the absence of full information despite the marvelous record made by the industry in meeting every demand made upon it. To keep the record clear in this respect is a task that should not be neglected.

One of the meters in the control room of Standard Oil of New Jersey's new fluid catalytic cracking plant. The operators can tell from a glance at the dial just how much catalyst is being fed into the plant and by the mere turning of a knob can increase or decrease this flow.

JERSEY STANDARD DEDICATES CATALYTIC CRACKING PLANT

Large New Unit Employing Fluid Catalyst System Is Among First of Nearly Thirty to Supply Aviation Fuel for Military Use

THE NEW "fluid" catalytic cracking plant of the Standard Oil Company of New Jersey at Bayway was formally dedicated with appropriate ceremonies on January 18 in the presence of a large number of invited guests, including members of the press, who were given an opportunity to inspect the plant.

Although the Bayway plant is the first of its type in the East, two other fluid catalytic cracking plants are in operation, one in Louisiana and the other in Texas. More than 24 others are in course of erection and have advanced to various stages of completion. Before the year is out all will be in operation, and then more than half of the total production of aviation gasoline base stock in the United States will be produced by the fluid catalytic process. The rest will come from plants operating by the Houdry and Thermofor catalytic processes, and from a certain number of thermal cracking plants. All together, these numerous installations will soon enable the petroleum industry to reach if not surpass the goal of a daily production of 250,000 bbl. of 100-octane aviation gasoline a day. This is far above the capability of the Axis powers to produce aviation fuel, both as to quantity and quality. It is understood that enemy airplanes are fueled with gasoline of octane number not above 87, which is markedly deficient in power and pick up as compared with 100-octane. However, by variations in engine design and by the use of additives the Germans are able to overcome a part of this deficiency.

Details of the construction of the Bayway plant, its operation and capacity, are under the ban of military secrecy, but the essentials of the process itself were common knowledge long before the United States was drawn into the war. Commercial catalytic cracking had its first beginning eight years ago with the Houdry process. In the Houdry process the catalyst is in the form of small pellets contained in a catalyst chamber; oil vapor is passed through the chamber, where it is catalytically cracked until the pellets of catalyst become coated with carbon to an extent that slows down the output. The operation is thereupon interrupted and the catalyst is regenerated by burning off the carbon in a current of hot air, whereupon the cracking operation is resumed. The Houdry process is thus discontinuous or periodic, although by having duplicate or triplicate sets of chambers a continuous stream of cracked products may be obtained.

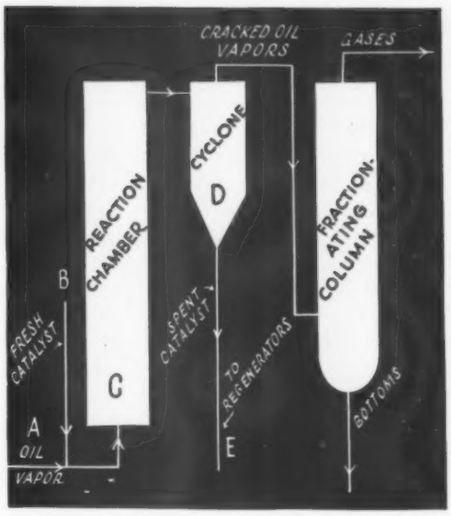
The idea of conducting the catalytic cracking in such a way that the process need not be interrupted for regenerating the catalyst was worked out several years ago, and has been explained in United States and foreign patents which antedate Pearl Harbor. These patents, however, merely explain the principle, and give little or no hint of the details which must be learned in order to make the operation practicable. The ac-

companying diagram, copied from old patent drawings, illustrates generally the flow of materials. Gas oil is vaporized in a furnace and superheated to a temperature of around 900° F. After passing through the usual tar separator the hot oil vapor passes through a tube A where it picks up the catalyst from a tube B leading down from the catalyst supply hopper. This catalyst is composed of a selected dry clay which has been ground to a very fine powder, so fine that it is easily suspended in the vapor in the form of dust. The mixture of oil vapor and catalyst dust then enters the bottom of a tall reaction chamber C. By the time the mixture reaches the top of the reaction chamber the cracking reaction is finished. The dust-laden oil vapors leave the reaction chamber and enter a cyclone separator D such as is frequently seen in woodworking plants and other places for separating solids from air. Here the catalyst dust falls down the pipe E. During its passage through the reaction chamber the catalyst particles have become coated with more or less carbon which depreciates their cracking efficiency. To remove this carbon the spent catalyst dust is taken from pipe D into another pipe (not shown) where it is mixed with hot air and blown upward through a large chamber (similar to the reaction chamber C) which is connected at the top with another cyclone separator in all respects similar to cyclone D. From the bottom of this other cyclone the regenerated catalyst is sent to storage hoppers from which it is again fed into pipe A to repeat the cycle.

From this it will be understood that a fluid catalyst plant is composed of two sections, which are practically duplicates of one another. In the cracking section the fresh catalyst is mixed with a blast of oil vapor. In the regenerating section the spent catalyst is mixed in exactly the same way with a blast of hot air; the two processes are so interconnected as to result in one continuous operation. The term "fluid catalyst cracking process" is of course somewhat of a misnomer; the powder is still a solid. But the catalyst is in the form of such a fine dust that when buoyed up in a stream of oil vapors, or of air, the whole mixture obeys the laws of fluid flow and so can be pumped or forced through straight or curved pipes, as though it were really a fluid.

After the gas oil has been cracked in reaction chamber C the cracked products pass out of cyclone D into a more or less conventional fractionating column, where the various constituents are separated from one another. The most valuable of these constituents are aviation gasoline base stock, butylene for synthetic rubber and alkylate, toluene for high explosives, and light and heavy fuel oils.

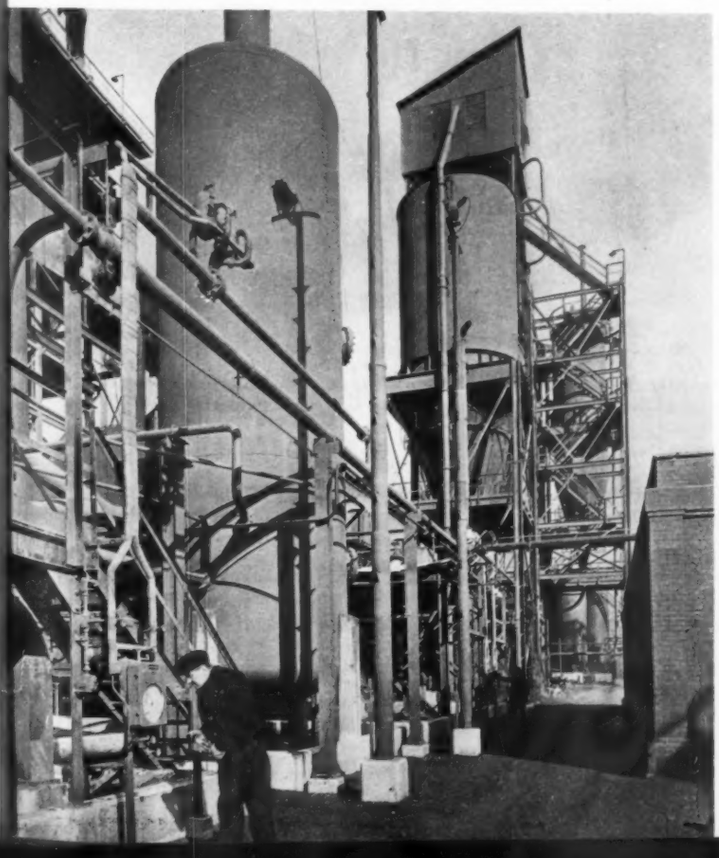
Unlike thermal cracking, which generally requires high pressures, catalytic cracking in general takes place at pressures that are little more than enough to maintain the necessary circulation through the apparatus. Like the older Houdry and other processes, the fluid catalytic process requires a cracking temperature of about 900° F. which may be higher or lower, depending on the object which the cracking technologist desires to obtain. Also like the Houdry and other similar processes, the temperature necessary for burning off the carbon from the spent catalyst is maintained at about 1100° F. The difference between 900° and 1100° represents a considerable amount of heat; this excess of heat is recovered by heat



exchanging arrangements which have long been standard equipment in the catalytic cracking art.

The foregoing particulars have been recorded in patent literature that for years has been accessible to all. But patentees generally disclose only enough of their inventions to establish their claim to the principle involved; apparently small details on which the practical and economical success of the invention depend are seldom mentioned. A mere reading of the patents will hardly enable an engineer to put up a big fluid catalytic cracking plant that will actually work. Back of the three plants now in operation and the numerous others nearing completion lies a long record of laboratory research and pilot plant operations which were necessary for establishing relations between

Workman taking a temperature reading. The cracking of petroleum is effected by heat and pressure and various operating temperatures throughout the plant are carefully controlled at all times.



Into these huge hoppers is fed the catalyst which controls the cracking of petroleum. Many tons of catalyst are used in this process, most of which is recovered, cleaned and recycled through the plant.

the various organs of a commercially successful plant, to settle necessary conditions of volume, time, velocity and temperature at various stages of the process, preparation of the catalyst, and innumerable small but vital details. Accumulation of this general "know-how" was begun by the American petroleum industry while the United States was yet at peace. It is a fortunate circumstance that the oil technologists made an early beginning on this development work, otherwise the vital part which the petroleum industry is now playing in the war effort would have taken a much longer time to get under way. When the war is over and the technologists are at liberty to publish their "know-how" it will make interesting reading.

Even after the development work on the fluid catalyst process had been well advanced there was some expectation that a full scale plant based on pilot plant experience and designed to treat thousands of barrels of gas oil a day might present operational difficulties. But none such have been encountered in the new Bayway plant. The mixture of oil vapor and catalyst dust in the big plant is as fluid and as manageable as in the pilot plant. The process is almost automatic and runs itself practically without attention so long as it is supplied with oil vapor, air and heat. The operation of every pump and compressor is indicated on an instrument in the control room. Other instruments show temperatures and pressures, and still others show continually how the catalyst is behaving. Although this Bayway plant itself has the capacity to handle as much oil as a more than average-sized refinery a crew of nine men is sufficient to operate it; most of these men spend their time in the control room watching the instruments and occasionally pressing a button to operate a motor controlled valve out in the plant.

One expected difficulty that did not show up was loss of catalyst, due to inefficient separation of the spent dust from the cracked oil products, and again in separating the regenerated catalyst from the gaseous products of combustion in the cyclones above the regenerating chamber. But these cyclones, supplemented by Cottrell precipitators, do an efficient job, and the physical loss of catalyst is a small fraction of one percent. Another expected difficulty was abrasion of metal parts by the swiftly moving particles of catalyst dust, but so far there has been little indication of excessive wear.

As was said above, the products of these fluid catalyst plants include materials for making aviation gasoline base stock, and butylenes for synthetic rubber. These butylenes, which include both normal and isobutylene, are usable for making alkylate (an ingredient of 100-octane gasoline) as well as for making rubber. Two vital parts of the war program thus compete for the same basic materials and the high command has to decide which, if either, is to be preferred.

There has been some discussion as to whether the production of 100-octane gasoline and materials for synthetic rubber is to continue after the war. It now appears to be certain that the automobiles of the future will run on this super-fuel with engines especially designed to use it. The future of the synthetic rubber industry is more obscure. It may be that synthetic rubber will be able to compete on a price basis with natural rubber; and it may be that world trade will be organized under the Atlantic Charter so that the Eastern regions will be allowed to share at least a part of the rubber market with the synthetic product.

These huge pipes contain products which are moved through the catalytic cracking plant after the oil has been cracked, or broken up into its many components.

Barrels of aviation gasoline being loaded aboard a cargo ship at a South Pacific port for shipment to U. S. forces in the Solomon Islands.

PETROLEUM'S RELATION TO THE STRATEGY OF WAR

Success of the United Nations in Defeating Germany's Attempt to Reach New Sources of Oil Supply Rated Among Important Achievements of the Past Year—Pacific Situation Less Favorable.

ACCEPTING the oft repeated statement that this is a war of oil and that dominance in control and utilization of petroleum products will be a decisive factor in its outcome, it becomes worth while to review briefly the impact of military operation upon oil supplies and oil industry activities during the year just ended and the relationship of oil to the future course of the conflict.

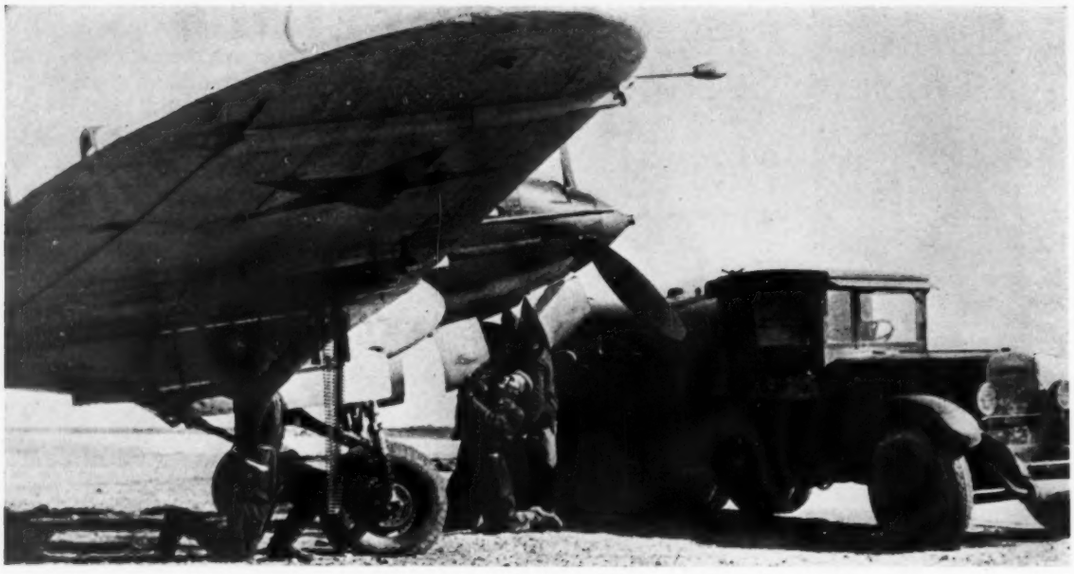
On the side of the United Nations 1942 was a year of great peril to vital segments of the oil producing areas under their control at the beginning of the struggle. They have lost possession of some important areas while others of greater strategic value have been under constant threat of attack and possible seizure by the enemy. The danger to the Allies indeed has been not so much the likelihood that they might be deprived of the oil resources and facilities needed to maintain their operations as the possibility that the Axis might so improve its position as to be able to prolong the contest for an indefinite period.

From the beginning of the Nazi invasion of Russia in the summer of 1941 it was clear that one of its main objectives was to gain control of the oil fields of the Caucasus, among the greatest in the world, and beyond that perhaps to open the way to other vast and only partly developed fields of the Near and Middle East. This purpose was made still more evident from the start of the 1942 campaign. Instead of concentrating attack on the approaches to Moscow and Leningrad as in the previous year, in the apparent belief that their capture would bring about the political and military collapse of the Soviet Union, the 1942 drive was aimed to the southeastward, pointing directly toward the sources of 85 percent of Russia's oil and seeking to sever rail and water communications between this all important region and the industrial areas further north.

For a time the attack rolled forward at high speed and with seemingly irresistible power. It recaptured Rostov, and from there pushed across the steppes, passed the Don and reached the Volga, Russia's great commercial artery. Further south it overflowed the Crimea, reducing Sebastopol after long and stubborn resistance, crossed the Kerch peninsula and spread along the northern short of the Black Sea. A strong Nazi force, swinging south from Rostov followed the main railway line toward Grozny and the Caspian. The first notable success in acquiring potential oil production was the capture of the Maikop-Kuban fields which lie on the western side of the Caucasus. While the Russians were not able to hold this area the strong vanguard stand of their small forces at the Laba River gained time to permit the firing of all surface structures and plugging or dynamiting of the wells. The conflagration that ensued raged for days and covered the surrounding landscape with a pall of smoke so dense that it was impossible to approach the fields for nearly a week. All that the victors gained was a blackened ruin which would require months if not years to restore to productivity. While statements from Nazi propagandists asserted that oil industry workers and oil field machinery accompanied the army and would quickly restore the fields to production it is doubtful whether more than the smallest fraction of the former 17,000,000 bbl. yearly output could be salvaged by the means at the command of the invading forces. At no time in fact were they left in undisturbed possession of the area. While the main Russian resistance was broken guerilla attacks on the Nazi forces continued and their harrying assaults have been sufficient to nullify efforts at reconstruction.

For a time it seemed that the fate of Maikop would be shared by the Grozny-Dahgestan fields with their yearly outturn of 15,000,000 bbl. Bitter resistance at the Terek River finally halted the Nazi troops when they were almost at the very gates of Grozny. Probably the failure to capture Stalingrad was decisive in stopping the advance on Grozny.

Baku, richest prize of the Soviet's petroleum resources, remained out of reach of the Germans because of their inability to complete their conquest of intervening districts. Had the drive against Grozny succeeded it would have brought the Nazis to the shore of the Caspian Sea at Makhach Kala and would have opened the way for easy progress down to the Apsheron peninsula through the Derbent gateway. The alternative route leads across the lofty mountain range that extends practically the entire distance from the Black Sea to the Caspian. While the Nazis made some diversionary gestures in this direction by their operations around Alagir and Ordonikidze they evidently decided that to attempt the narrow mountain passes under winter conditions when they are blocked by snow was an undertaking too hazardous to be attempted. Even if an attacking force could get through it would be extremely difficult if not impossible to keep it supplied. The Russian stand at Stalingrad upset the Nazi timetable for the entire southern drive and made it necessary to defer until the 1943



Plane being refueled before take-off on the Karelian front.

campaign the attempt to gain full possession of Caucasian oil.

Now it appears probable that all the blood and effort expended by Hitler in this attempted conquest may go for naught. The southward push of Soviet armies in the Don bend and operations further south at Kotelnikov were designed primarily to isolate troops before Stalingrad. This movement was carried out rapidly and was completely successful. It was followed by a broader envelopment by Soviet armies executing a wide sweep from north and south and converging along the river and railway approaches to Rostov. In the early days of January the Russians had penetrated to within thirty miles of that city and had retaken hundreds of square miles of territory occupied by the Germans during their summer advance, although the latter still retained possession of several strong points along the reconstituted line.

The westward sweep of the Russians imperiled the position of Nazi troops in the Caucasus by threatening to sever their supply lines. Pressed by vigorous Soviet attacks they fell back from Mozdok and Nalchik along the route of the railway and pipe line leading from Grozny to Rostov. How far this withdrawal will extend remains to be seen. Presumably the German general staff has a line prepared which it intends to hold during the winter but unless the Soviet progress can be stopped before Rostov it will necessitate the relinquishment of all the territory east and south of the Sea of Azov and may conceivably cancel all Hitler's important 1942 gains and put him back to the position he occupied at the beginning of last year but with diminished striking power as a result of the heavy toll taken of his legions by the aggressive Russian fighters. For the present at least the predominant part of Soviet oil resources seems to be beyond reach of the Nazis and the minor fields of Maikop-Kuban have been retaken by the Russians in their sweeping drive to clear the Caucasus.

Rommel's drive through North Africa which forced the British out of Libya and did not halt until it was dangerously near Alexandria undoubtedly was part of the same grand strategy that conceived the invasion of the Caucasus. Presumably it contemplated the seizure of Suez, the Egyptian oil fields and a possible junction with the northern armies on the eastern side of the Mediterranean which would have given the Axis control of the oil resources of the Middle East or at least would have made them useless to the United Nations. As has been pointed out in previous articles in these pages the mere possession of any of these fields, even those of Baku, while it would be a heavy blow to the United Nations would not solve the Axis oil problem. There would remain the question of transportation and if railway and river routes were the sole means of moving oil to central and western Europe it could not be conveyed in sufficient volume to meet the wartime needs of the Axis. In order to obtain the full benefit of these oil supplies it would be necessary for Hitler and his minions not only to get possession of them but also to drive the British fleet out of the Mediterranean. Then it would be possible to make use of deep water transportation from points on the Black Sea or the eastern Mediterranean to Adriatic, Italian and southern French ports for distribution to the areas where they were most needed.

In a way the rolling back of Rommel's forces from the borders of Egypt during the final weeks of 1942 was as spectacular as the resurgence of Russian power after Stalingrad was all but lost. For the United Nations it was almost as important in postponing and probably defeating Hitler's ambitious plans for bringing into his grasp the one essential war material that he lacks. If the British and Americans succeed in expelling the Axis entirely from North Africa it not only will safeguard the position of Egypt's oil fields and rule out a renewal of the attempt against Suez and the Near East but it will greatly strengthen the position of the United Nations by enabling them to use the western Mediterranean for the movement of troops and supplies and will go far toward completing the encirclement of the European members of the Axis which is the basic feature of allied strategy.

While opinions differ as to the actual situation regarding petroleum supplies within the Axis controlled countries of Europe certain pertinent facts in this connection are known. One of these is that the entire natural production of crude oil within this area at the beginning of the war was less than 8,000,000 metric tons and that the outturn since then has decreased rather than increased; gains in certain districts have been more than offset by declines in others, notably in Rumania. Even if the synthetic production of gasoline and fuel oil has been expanded to the full extent of German claims the combined production is insufficient to meet the military needs of a two thousand mile front in the east, plus the Mediterranean front, plus the large establishments required to garrison the subjugated countries and to maintain a defense against air and sea attack along the Atlantic Coast from Norway south to the northern border of Spain. Such shortages as exist moreover undoubtedly are most acute in the products that are most essential, that is in high test aviation fuel and lubricants.

Putting aside any conclusion based on statistical estimates the military record of the past year shows that German air power has been less effective than in the earlier stages of the war. At the beginning of the eastern campaign its superiority over that of the Russians was clearly marked but its blows grew weaker as the season advanced.

In North Africa a similar slackening in the power of German air attacks upon the British forces was noted. Evidences of a lack of fuel for planes and ground transport in the form of machines with empty tanks was found by the British in their pursuit of the enemy as he fled westward across Libya. More convincing still has been the weakness and infrequency of German air raids over Britain. Had Hitler been in a position to reply in kind to the destructive attacks of British and American bombers upon the industrial centers of the Reich, he certainly would have done so. It is a fair assumption that the expansion of the Luftwaffe has not kept pace with the broadening reach of Nazi military operations or else that its activities have been limited by restricted supplies of fuel and lubricants.

Old and new means of transportation meet on a highway somewhere in India, both hauling essential materials for U. S. forces stationed there.

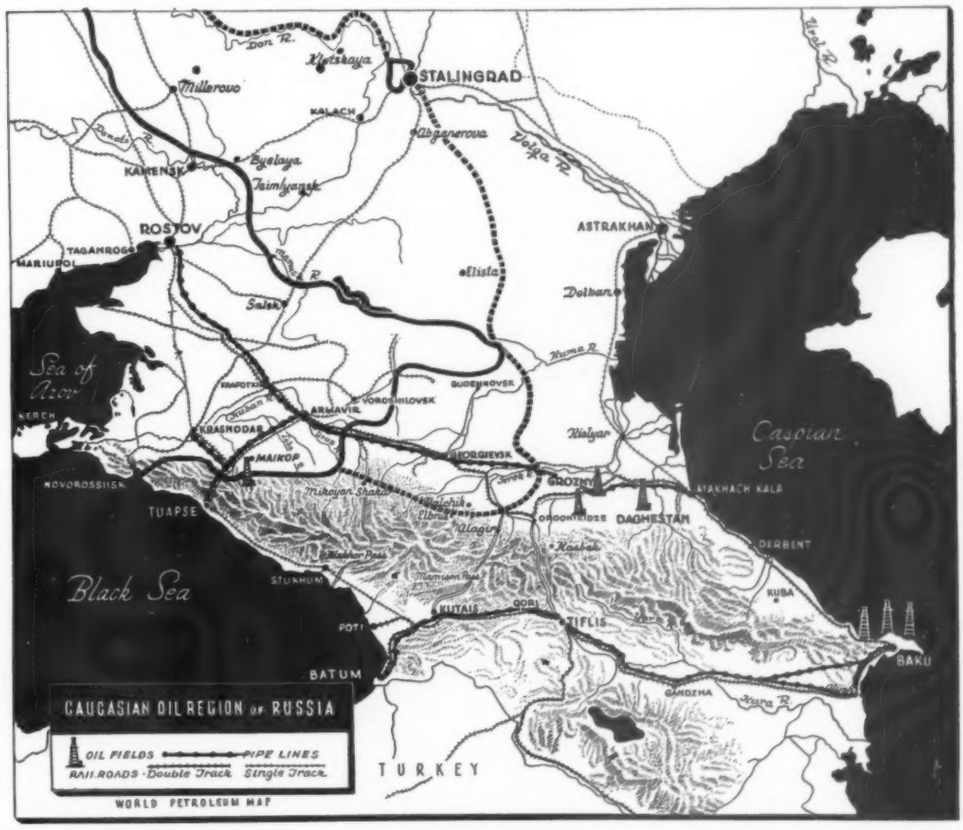
On the other hand the growing air strength of the United Nations has not been hampered by any lack of fuel. Such difficulties as they have encountered have been those of transportation and it is definitely stated that no plane, tank or ship has been kept from its allotted task by lack of petroleum supplies. The experience of the past year has confirmed the necessity of maintaining the movement of these supplies to the various fighting fronts in pace with the rising scale of military activities—a need that is not likely to be overlooked by those responsible for allied strategy. At the same time it emphasizes the vital importance of keeping Hitler from replenishing his inadequate supplies of oil, of defending the approaches to those areas where he might obtain fresh supplies and of pressing home the destruction of his manufacturing and transportation facilities. Such a procedure may not in itself win the war but it assuredly will bring much nearer the day of ultimate victory.

At the other end of the Axis line—in the Pacific—the developments of the past year have been far less heartening to the Allies. Following the sneak attack on Pearl Harbor which temporarily immobilized a large part of the Pacific fleet of the United States, the Japanese quickly overwhelmed and took possession of the principal oil producing areas of the Far East. The weakly defended East Indies—Borneo, Sumatra, Java—successively fell before their onslaught and these successes were followed by the conquest of Burma. In all of these districts the destruction of wells and refineries was carried out in accordance with plans carefully prepared in advance of their capture. To what extent the Japanese have been able to restore production no reliable information is obtainable. In some of the islands the invaders have been satisfied to hold the ports and apparently have made little attempt as yet to occupy the areas lying in the interior.

Owing to the shallowness of the wells in certain of the East Indies and the easy drilling conditions the sinking of new wells is a matter of no great difficulty and the refining capacity of Japan proper is sufficient to process the crude thus obtained. It is considered entirely probable therefore that the Japanese are obtaining sufficient supplies to meet the needs of their military establishment. Yearly production of the East Indies prior to the war was of the order of 60,000,000 bbl. Two-thirds of this, however, came from Sumatra and it is not believed that Japan as yet has been able to obtain any appreciable amount of oil from Sumatran fields except possibly small amounts from the northern part of the island.

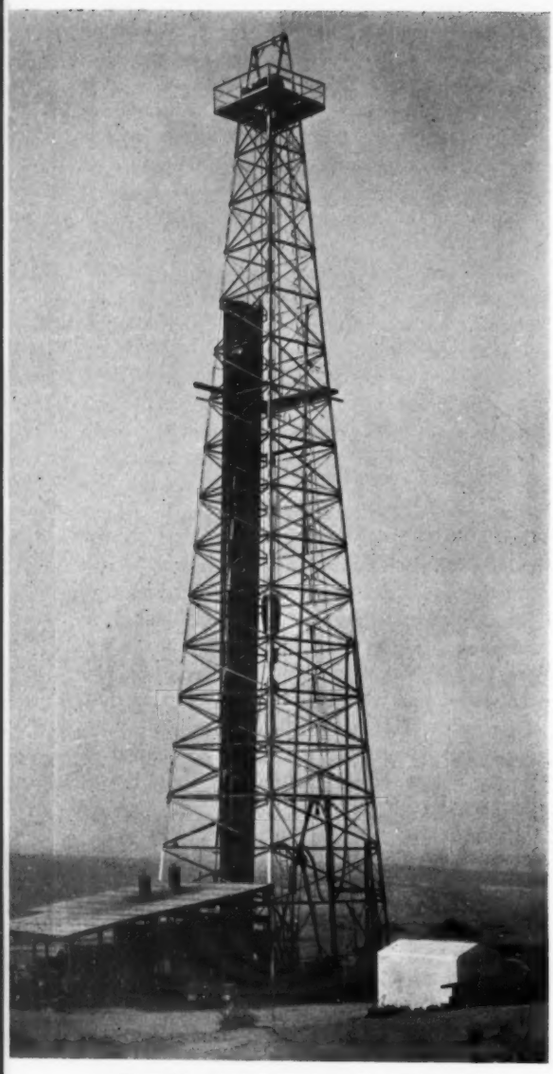
The situation of Japan, however, both industrially and strategically, is quite different from that of Germany and Italy. While it may be possible to wrest from the Japanese the oil producing areas that they have occupied, this is an undertaking that obviously must wait upon substantial accretions to the naval and air power of the Allies in the Pacific area. Even there it may be a question whether the necessarily slow procedure of investing and reducing the many strong points controlling the areas in which they have established and entrenched themselves is the best way of overcoming this enemy. Japan's vulnerability lies rather in the concentration of war production plants in locations exposed to attack and the shipping routes that connect the different islands.

Strategists seem to agree however that ultimate success against the Japanese will depend mainly upon disruption of the lines of communication with their occupied territories and carrying the attack to military and industrial objectives in their homeland. That, rather than recapture step by step of the territories from which Japan is drawing foods and raw materials is regarded as the most effective means of breaking its power of resistance. Thus, while the strategy of oil for the United Nations differs in its application in the eastern and western theatres of war the fundamental purpose in both cases is to reduce by the means best available the supplies obtainable by the enemy while retaining the full use of those under control of the Allies.



The dotted line in this map shows deepest penetration of German forces into the Caucasian oil region of Russia; while the solid black line shows battlefront as of January 20. Russians since have freed the entire Caucasus oil region.

PRICE AS A FACTOR I



Two Diesel engines operating a circulating pump and rotary drilling rig in Kansas.

ALTHOUGH much has been said and written about the vital part played by oil in modern war the fact is that until now the tremendous demands made by the present world struggle upon the petroleum resources of the United Nations—which by force of circumstances fall largely upon the United States—have not been fully understood even by those who are close to the conflict by reason of their official positions. Even now when shortage of petroleum products arising from the imperative needs of the fighting forces is beginning to be felt by the civilian population there is only a hazy appreciation of the extent to which growing military requirements will absorb the oil supply which in the past has kept the wheels of 30,000,000 motor cars turning. It is almost beyond comprehension to the average American that a scarcity can exist in a commodity that always within his recollection has flowed in seemingly inexhaustible volume from hundreds of thousands of roadside pumps.

In part this failure of the general public to grasp the enormous quantities of petroleum products required to keep in motion the ships, tanks, trucks and planes that are waging this global war is due to lack of information as to the amounts that have been and are being consumed. In part it is due to the fact that the conflict itself is assuming dimensions that never had been envisioned. War and Navy officials do not reveal the size of the shipments being made to allied forces overseas for the sound reason that they regard this as information that would be useful to the enemy. For the same reason statistics of exact production of petroleum war materials are kept confidential.

It is admitted and indeed emphasized however that the consumption of petroleum products for direct war purposes has risen far beyond early estimates and will continue to rise steadily as more and more ships come into commission, more and more planes take to the air and more and more troops with their elaborate mechanical equipment move into action in this circumferential war which the United Nations are waging. With such familiar facts as are provided by the knowledge that a single flight of an average sized group of bombing planes may call for 100,000 gallons of aviation fuel, that the trans-ocean movement of a large convoy or an expeditionary force may require much more than a million barrels of fuel oil and that one armored division will burn 1,000 barrels of oil in traveling a hundred miles it takes no great ingenuity on the part of friend or foe to calculate that the enormous scale on which allied operations are projected will call for the use of oil products on a scale never approached heretofore except in the domestic economy of the United States itself. In 1941 an estimate that war activities might absorb half the oil production of the country was regarded generally as being much in excess of probable needs. Today the basis of estimating future war requirements is that these may absorb practically all the present output of nearly 4,000,000 bbl. daily and that imperative domestic needs may have to be met by increased production.

This situation has brought to the fore important questions that have remained in the background during the first year of war. It was natural enough that during this earlier period attention should have been concentrated on the provision of plant, equipment and supplies for producing such things as 100-octane gasoline, toluene and butadiene. So well has this job been done that up to the present time no ship or plane or tank on the allied side has failed to move on schedule for lack of fuel. Nor is there apprehension as to the ability of the country to meet actual military requirements notwithstanding the great expansion they are undergoing. Army and Navy officials have expressed themselves as satisfied that the petroleum needs of their respective establishments will be met during the coming year and beyond that as long as the present conflict is likely to continue. Nevertheless problems of production admittedly are as vital as any confronting the oil industry today and their solution is a matter of urgent necessity if the industry is to continue on a sound and stable basis and if it is to retain the ability to satisfy the heavier demands that are certain to be made upon it in the longer future as well as in the period immediately ahead.

The problem is not merely one of meeting the military requirements imposed by the war itself although these are involved so far as certain special products are concerned. It is rather a question of putting the industry in a position to operate with safety to its own future on a basis of higher production and consumption for a long period ahead.

Summing up the findings of various committees that have investigated the outlook for future oil supply and the opinions of men of broad technical knowledge there seems to be general agreement upon the following points: (1) While it would be possible to increase the daily rate of withdrawal from American oil fields such an increase could not be maintained for any great length of time without loss of ultimate recovery. Certain fields are capable of a substantially higher rate of production without injury but these fields are so situated that it is not possible immediately to supply adequate transportation facilities. (2) Since production from developed fields does not remain constant but follows a declining curve it is necessary to make continual additions to productive areas to offset this decline. (3) Discoveries during the past few years in the United States have shown a continuous decrease; the size of new fields brought in has become progressively smaller. (4) There is no reason to assume that the United States has reached or nearly approached the limit of its undiscovered reserves; there is evidence that more extensive exploration will be required to make the same additions to known reserves as in former years.

While discoveries of petroleum deposits in entirely new locations have fallen off 60 percent in the past five years the total estimated volume of known reserves continued to rise up to 1941 through extensions of known and partially proven fields. These increments however have been at a steadily declining rate, and since the new fields

OIL INDUSTRY'S PROGRESS

Rising Cost of Finding Oil Necessitates Stronger Incentive to Exploration—Inadequate Return from Well Operation Threatens Permanent Loss of Important Known Reserves.

found have been of smaller size from year to year the additions to reserves from extensions of these fields must be expected to show a progressive decline.

From the viewpoint of national welfare the situation before the United States is one that calls, first, for the conservation of its known petroleum resources to the end that none of these shall be lost or wasted and, second, for the expansion of its reserves by a thorough and widespread search for additional deposits in all those areas where conditions favorable to the discovery of oil are found to exist. To maintain a high level of production over the longest possible period it is necessary to handle carefully that which we now possess as well as to extend these possessions by energetic search for new sources of supply. Looked at from this angle there are at least four phases of the general problem which require consideration and for which provision should be made in any plan for attaining optimum productivity in the management of the national oil resources.

First among these stands of course the acceleration of the search for new fields, the broadening of areas to be surveyed and the increase of exploratory drilling. Granting the claim that the majority of the fields most easily located from surface indications or established methods of geophysical survey have been discovered (although this has not been conclusively established) it would seem that the time has arrived for the development of lean or marginal properties which have been left aside while more inviting prospects were at hand and that a second step in a program of full utilization of latent oil power should include means of making such sources available.

Of the 400,000 producing oil wells in the United States, nearly three quarters have a very small individual output averaging less than two barrels a day. In the aggregate, however, these wells yield each year more than 200,000,000 barrels or nearly as much as the total outturn of Russia or Venezuela, the world's largest producing countries aside from the United States. Ten thousand of these wells are being closed down each year, not because they are exhausted, but because it is no longer possible to operate them at even a meagre profit. When they go out of commission millions of barrels of potentially recoverable oil pass beyond hope of recovery. With so large a stake involved any thorough going plan for the conservation of natural oil resources should include as its third provision the rehabilitation of as many as possible of these small wells and postponement of their abandonment as long as may be practicable.

A phrase that has appeared with growing frequency in the literature of oil in the past score of years is secondary recovery. To oil men it connotes the replacement by artificial means of the underground pressure that is the driving force bringing oil to the surface or within reach of the pump. It is applied principally to the wells of small production referred to above but it deals with the wells in a particular field collectively instead of individually. The possibilities of increasing production by secondary recovery cannot be computed exactly but they are estimated at between 2,500,000,000 and 3,000,000,000 barrels in fields of small stripper production alone. Here is another impressive quantity of oil known to exist and representing a fourth phase of conservation to be provided for in any comprehensive scheme for maximum utilization of obtainable oil.

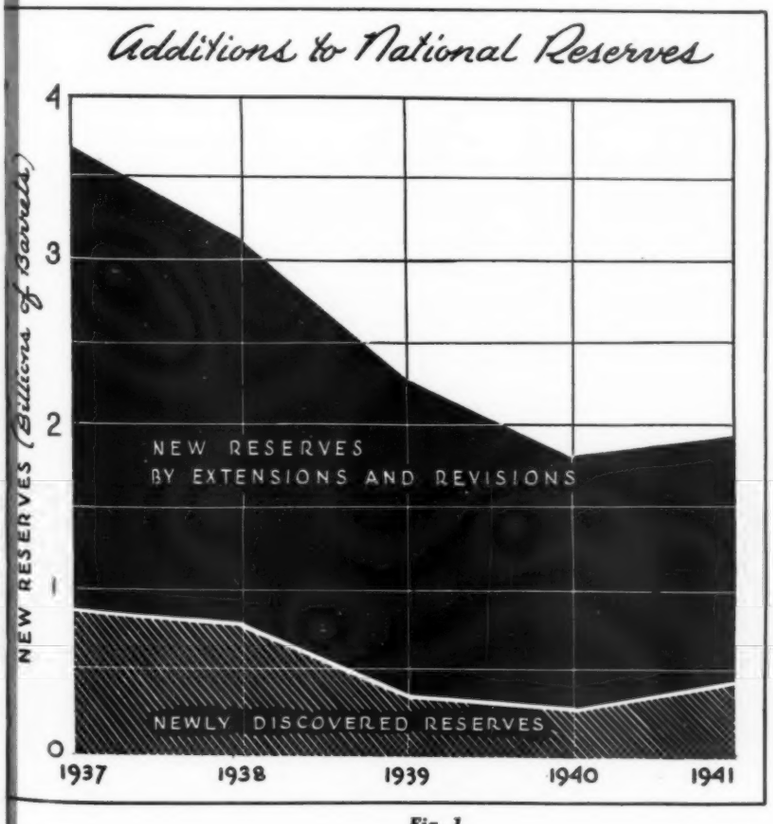


Fig. 1.

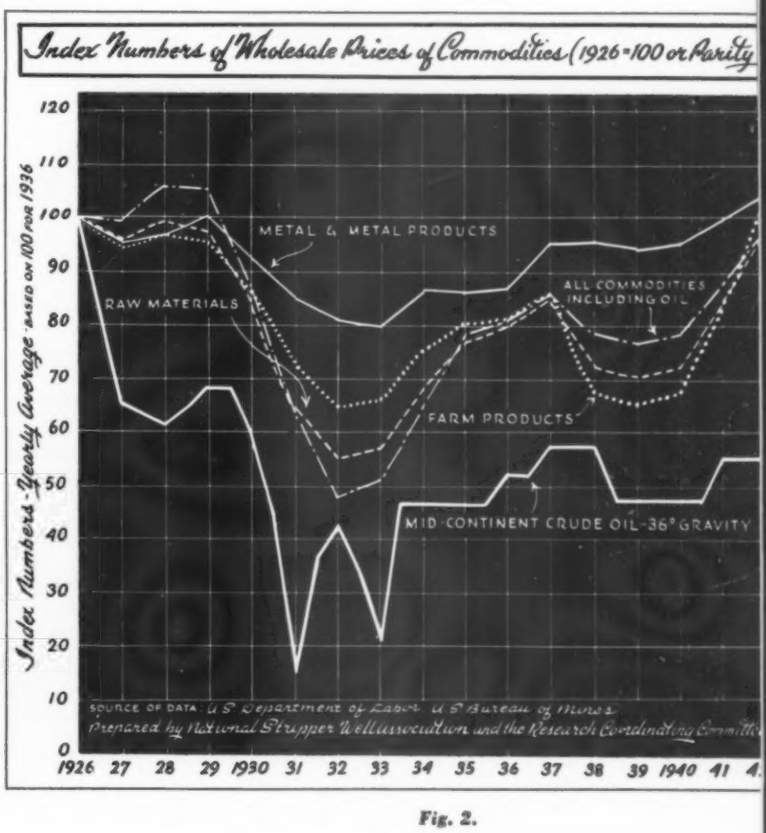
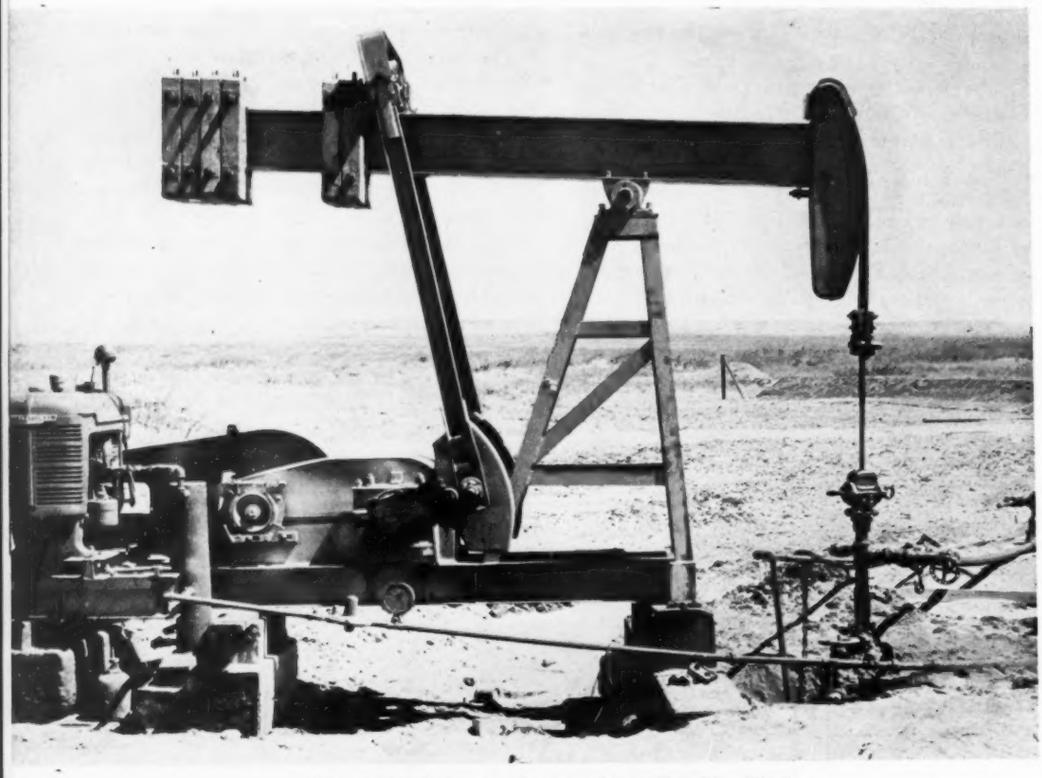


Fig. 2.

Concern over the nation's reserves has been caused by the steady decline in the volume of new deposits discovered in the past few years. Statistics show that additions from the location of entirely new fields decreased from 896,692,000 bbl. in 1937, to 280,882,000 bbl. in 1940. During 1941 when the number of wildcat wells drilled increased to 3,264 or 20 percent more than in 1937 there was an improvement in this respect with discoveries rising to 429,974,000 bbl. but this was still less than 50 percent of the volume of 1937 discoveries. While the amount of the country's proved reserves as calculated by a special committee of the American Petroleum Institute continued to grow down to and including 1941, this was made possible by extensions of existing fields and revisions of their reserves based on added information. The rate of this growth is likewise declining however and with a continuing decrease in the size of new fields brought in, this downward trend naturally will become more pronounced. With a growth in withdrawals and a declining curve of discoveries the time when we shall begin to draw upon accumulated reserves is measurably within sight.



International power units pumping well in New Mexico.

Various explanations have been put forward to account for the failure of exploratory drilling to add as much as formerly to the country's oil reserves. One is that the amount of undiscovered oil is approaching exhaustion. Another is that the methods of survey employed for determination of favorable locations for drilling are no longer effective and that new methods must be developed. Neither of these explanations is accepted by leading geologists. They do agree that future discoveries are likely to involve greater cost and effort than those of the past. They hold that such discoveries must be sought in regions not yet explored, by testing second rate prospects that have been passed over heretofore while more inviting ones were available, by penetrating to deeper structures and by finding more stratigraphic traps which are difficult to locate by surface observations and are opened usually by extensive drilling with a larger than average proportion of dry holes.

All of this sums up to the conclusion that to keep reserves at a satisfactory level in relation to the increasing rate of withdrawal, it will be necessary to combine various methods of survey, to do more and deeper drilling and to explore less conveniently located and less promising areas. This in turn brings up the economic factor which cannot be disregarded in the consideration of this subject. The cost of finding oil is rising and so far as can now be foreseen will continue to rise. The footage of dry holes that must be drilled in order to locate a producing well is becoming larger and if the extensive program of exploratory drilling called for by present conditions is carried out it undoubtedly will become still greater. While there is of course no uniform cost of finding oil, the estimate of leading authorities based on the factors previously mentioned and on some others of a more technical character is that such costs are likely to be from 50 to 100 percent higher in the early future than they have been in the recent past. Practical field operators are virtually unanimous in asserting that under the fixed ceiling price now established for crude oil wildcatting does not pay. In order to stimulate more active and intensive search for oil they insist that it is necessary to have a higher price for crude oil in order that the one hole in six or more that becomes an actual producer may have at least a reasonable chance of making good for the inevitable failures.

Price, it is agreed, is the principal but not the sole factor. Repeated attempts by representatives of the Federal Treasury to lower the depletion allowance on producing wells has acted as a deterrent to assuming the risk of drilling as have threats of a change in the proportion of charges to intangibles. In general however an increase in the price of oil that would bring it more nearly into line with the advances that have taken place in other commodities is accepted as the most certain means of leading to a substantial gain in discoveries. Certain it is that in the past a close relationship has existed between the price of crude oil and the extent of exploratory drilling expressed by the number of dry holes drilled. This relationship is strikingly shown by Figure 4 accompanying.

Under the normal interaction of economic forces a rise in demand would bring about a price advance which in turn would stimulate the enlargement of supply. Even the prospect of an approaching rise in consumption would be heralded by an anticipatory upturn in the price curve. With the price of oil arbitrarily held down by a ceiling imposed by governmental authority these factors cannot operate in their customary manner. The position maintained by Leon Henderson while he occupied the post of Price Administrator was one of consistent opposition to a general rise in the price of oil. The reasons advanced for this attitude were that an advance in the crude price would be followed by a corresponding increase in the prices of products. This, he held, would add to the burdens of the consumer and would confer benefits upon the whole body of producers, many of whom would contribute nothing toward the search for new supplies of oil. The contention of Mr. Henderson has been that an increase of fifty cents per barrel, for example, in the price of crude would cost the consumers of the country $700,000,000 in the course of a year and that only the smaller part of this sum would be expended in exploration. As against this theoretical opinion however stands the estimate of Prof. L. C. Uren* that the drilling of 30,000 wells of average depth with the increasing costs now making themselves felt would require an investment of $750,000,000. Thirty thousands wells is only the average number drilled during the past few years and is considered insufficient to provide the additions to reserves and production set forth as needed under present conditions. Assuming the correctness of

*WORLD PETROLEUM, March, 1942, "Wartime Problems of the Petroleum Drilling Industry."

the above cost estimate it would be necessary to expend on drilling more than the additional income derived through a price increase of fifty cents per barrel in order to put the industry in a strong position to meet probable future demands. The experience of the past and the opinion of competent economists supports the view that a price incentive would be the most certain means of attracting outside capital to assume some of the risks of wildcat drilling.

While no well formulated plan for bringing about a substantial expansion of oil reserves has been submitted as an alternative to the time tested method of increased price, the suggestion has been advanced by Mr. Henderson and others of his school of thought that it would be more effective for the federal government to appropriate an equivalent sum to be expended in scientific methods of survey and exploration either directly by the government or through a subsidy for wildcat drilling by individuals or companies. This proposal has drawn severe criticism on many counts but no support from any group familiar with the requirements of oil search. It is pointed out that if government is to pay out money for drilling some government bureau must necessarily approve and supervise each subsidized operation, that such a government agency would be under strong pressure to distribute its permits on a political basis rather than according to geological conditions—each state and district would want a chance to test the possibility of oil within its borders—and that it would substitute the opinion of some bureaucrat in Washington who might know little or nothing of local conditions for the judgment, however erratic, of the man who proposed to spend his own dollars in the test of an untried area. Attention is called to the fact that state controlled exploration, wherever tried, has been far less successful than has been dependence on private enterprise. A time of emergency like the present is generally agreed to be the worst of times to substitute new and doubtful methods for those that have proved uniformly successful over a long period of years.

The reason advanced originally for the limitation of price increases through the imposition of "ceilings" was that it would serve to prevent inflation. The argument put forward in support of this claim was that under wartime conditions the purchasing power of consumers was rising rapidly while the supply of goods was diminishing and that competition for this lessening supply would result in runaway prices unless some curb were applied. This argument has no application to petroleum however inasmuch as price and the quantity buyers are allowed to purchase both are strictly regulated by government order. Consequently there is no possibility of consumers indulging in extravagant purchases of oil products or of influencing the price by their purchases. It is demonstrable that while the average price of all commodities has risen approximately to their 1926 level the price of oil is still 45 percent below that level. The burden upon consumers of permitting oil prices to come closer into line with other commodities would be negligible and its effect in encouraging inflation would be exactly nil.

If it is acknowledged that the establishment of a reasonable price incentive will encourage wildcatters to go out and drill unexplored areas in the search for oil, it must be true also that it will stimulate the exploration of lean or marginal sections surrounding existing fields and the second rate prospects covered by geologists' reports which have been laid aside pending a time when conditions might justify the higher degree of risk involved in drilling them. Every active producing company has numbers of such reports in its files and reconsideration of some of these undoubtedly would be in order if the potential return from discovery of a producing well were greater than it is at present.

While the discovery of fresh reserves is necessary in order to sustain a rising rate of yearly withdrawals the maintenance in operation of wells now in production and the protection of reserves known to exist can hardly be assigned a place of minor consequence. It is here that the stripper well becomes of special importance. As previously mentioned approximately three-fourths of all the producing wells in the country are in the stripper class with an average yield of slightly under two barrels per well per day but with an aggregate outturn of over 200,000,000 bbl. annually. An extensive study of the situation of this numerically impressive and economically important segment of the American petroleum industry has just been completed by the National Stripper Well Association and this survey presents an array of facts that cannot be overlooked in any serious consideration of the industry's future.

By their very nature stripper wells are a marginal group. Under the most favorable conditions their earnings are extremely small. The original investment in drilling and equipping them has long since been written off, in theory at least. They are kept going only because mechanism has been developed for pumping them at very slight expense. Even so a drop in the price of crude or an increase in the cost of their maintenance and operation puts many of them in the red and forces their abandonment although they might be capable of adding their small rivulets to the huge stream that constitutes the nation's oil supply for many years to come.

One of the significant facts brought out by the survey referred to is that wells of this class are being abandoned in increasing numbers which in 1941 and 1942 had risen to over 10,000 yearly. In the main wells are closed down because of lack of manpower to operate them, because they are being run at a loss with no prospect of a change in this condition or because the salvage value of their equipment is greater than the prospective return during the period for which the

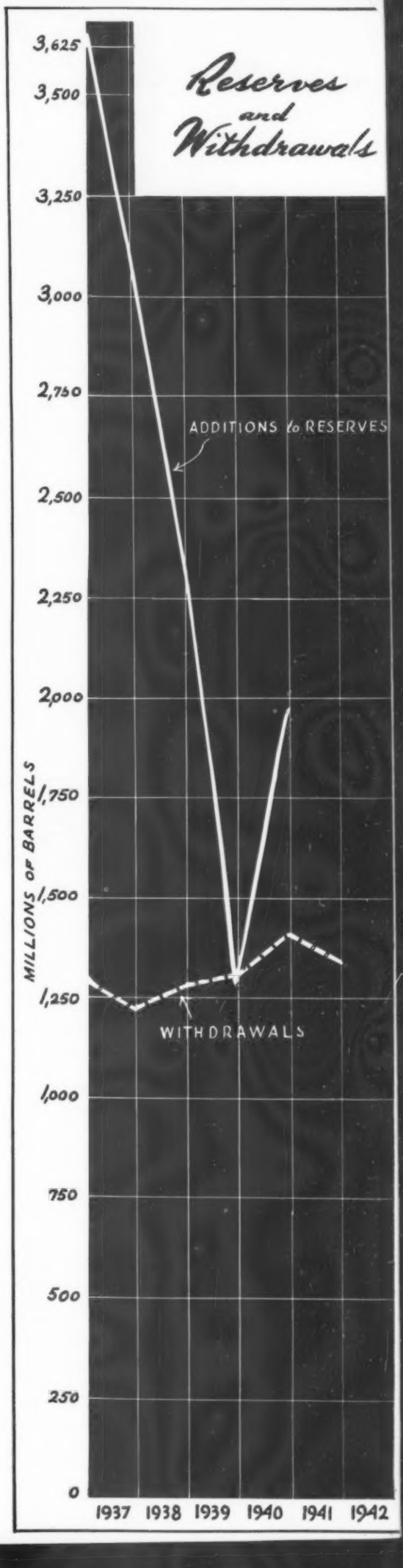


Fig. 3.

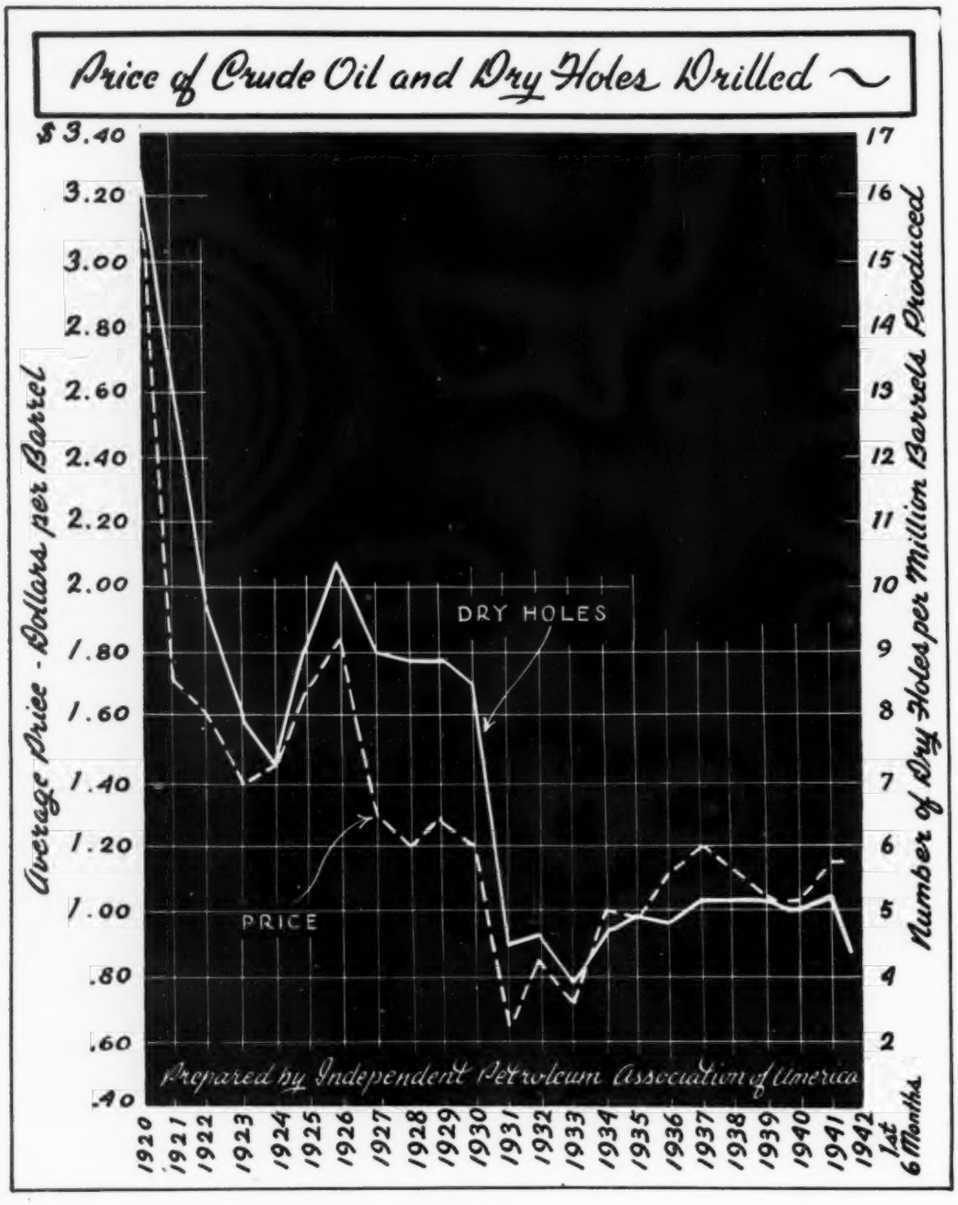


Fig. 4.

equipment will last. Production from some of these wells could be increased by expenditures for cleaning and rehabilitation but under present conditions there is no chance of recovering the out of pocket cost of such work aside from any question of a return on the investment.

Abandonment of these wells is of less consequence in its effect upon annual production than because of the permanent loss of their underlying reserves. According to the report 67,458 wells were abandoned during the period from 1935 to June 30, 1942, representing a loss of 216,506,778 barrels of oil recoverable by primary methods without taking account of additional quantities obtainable by secondary methods of recovery. Furthermore, each well closed down decreases the possibiilty of introducing secondary recovery systems in its particular area. Total stripper well reserves recoverable by primary methods are computed as 1,304,613,000 bbl.

Stripper wells naturally are proportionately most numerous in the older producing areas but they are to be found in all parts of the country. The largest number are in Oklahoma, with California, Texas, Kansas and Pennsylvania following in the order named. In Kentucky, Missouri. New York, Pennsylvania, Tennessee, Utah and West Virginia the entire production is from stripper wells. Much of this production is high grade crude especially suitable for products particularly in demand during this period of emergency.

Underlying the 300,000 stripper wells of the country are more than 4,000,000,000 bbl. of reserves, approximately 20 percent of the country's total proved reserve. Of this quantity 1,305,-000,000 bbl. as previously stated are computed as producible by primary methods. To recover the remaining 2,780,000,000 bbl. recourse must be had to secondary methods, to the injection of water, gas or air as a means to forcing underground deposits within reach of the pump. Such measures of course must be applied to fields rather than to individual wells and their successful application involves specialized ability and technique. Secondary recovery systems are widely employed in the eastern oil producing states but are less extensively in use in other parts of the country. In Pennsylvania, for example, the greater part of the current output is obtained from fields in which secondary recovery systems are installed. Studies of certain areas have revealed that they have produced more oil within the few years since repressuring systems were introduced than in their entire previous history. It is impossible to estimate how vast an amount of oil has been lost in years past through lack of knowledge of recovery methods but the quantity is tremendous. In view of the increasing difficulty and cost of locating fresh reserves the country can ill afford to waste 4,000,000,000 bbl. known to exist and known to be in large part recoverable. This again is a case in which the primary essential is a price for oil that will justify the expense of initial installation and subsequent operation of systems of secondary recovery.

Even a superficial examination of the conditions surrounding the expansion of the available oil supply and its most effective utilization reveals that many factors are involved. The replenishment of reserves through discovery of hitherto unknown deposits is only one though a highly important one of these. The preservation from loss and the ultimate maximum recovery of oil known to be present underground in areas now producing is another. Experience, technological study and invention have supplied us with means both of discovery and recovery that were unknown a generation or even a decade ago but the employment of these new methods and instruments is expensive. There is abundant evidence to indicate that the location and production of oil has entered an era of higher cost which may not be permanent but certainly will continue for a considerable time to come and that adjustment to this change has not yet been completed but must be made if the industry is to continue its progress.

In the past the growth of the oil business and its spread across the country has been due to the initiative and venturesomeness of individuals—to the well known willingness of Americans to take a chance, even a long chance, in the hope of substantial financial reward. The profit motive has been a compelling force but the profits as a whole have not been large in spite of a few conspicuous exceptions. No other incentive equally effective in producing results has been discovered anywhere else in the world. National self interest no less than fair dealing with the men who run the risks and stand the losses inseparable from the operation of the industry dictate the removal of fetters upon the normal functioning of the law of supply and demand which are now hampering the growth of the industry and its ability to continue rendering the highest possible service to the country.

NEW HOUDRY PROCESS FOR SUPER AVIATION FUEL

Eugene J. Houdry

EUGENE J. HOUDRY, president of the Houdry Process Corporation, announced on January 18 the development of a new catalytic process for production of a superior high octane aviation fuel. Designated as an adiabatic catalytic cracking method the process utilizes heavy naphtha to derive an aviation fuel said to be of higher octane equivalent than has been produced commercially heretofore. Since it is declared to be ahead of current engine design its immediate value will be as an additive to aviation fuel now being manufactured and it is held to pave the way for further raising of the standards of this type of fuel contributing to greater speed, a wider flying range and heavier loads for military planes.

Other advantages claimed for the process are that by utilizing heavy naphthas which in large quantities are a drug on the market it will make possible increased production of aviation fuel without a corresponding increase in crude oil production and without adding to the strain on crude transportation facilities. Also, it is stated, refineries embodying this process will be simpler to construct than existing catalytic cracking units and will require smaller amounts of critical materials.

The Houdry adiabatic process was developed early last year in the search for an economical, certain method for making butadiene, main ingredient of Buna S synthetic rubber. The principle was thoroughly tested in a semi-commercial butadiene plant built several months ago by the Sun Oil Company. This plant demonstrated the feasibility of producing butadiene by a catalytic process on a reasonably large scale, with perfect control and without operating difficulties. Members of the research staff thereupon turned their attention to adapting the adiabatic principle to the production of aviation fuel by catalytic cracking and developed the process on a pilot plant scale with satisfactory results. Engineering and construction of commercial units are now under way.

In further explanation of the Houdry processes for both aviation fuel and butadiene it is stated that they have overcome the difficulties with carbon which impairs catalytic activity in the cracking of oil and gases. Scientists of the Houdry organization have developed a technique which turns this troublesome factor to advantage by converting the carbon deposit on the catalyst into heat needed to rearrange the hydrocarbon molecules into the desired product without the use of materials for equipment to handle extraneous heat exchange.

Catalytic cracking of oil for aviation and automobile fuel was commercially developed by Houdry after fourteen years of experimentation and was the first catalytic cracking process to be used. The first commercial Houdry catalytic cracker went into operation in 1936. For six years this was the only process producing aviation gasoline base stock by catalytic cracking.

During the past year sixteen Houdry catalytic crackers, operated by four major oil companies, produced over ninety percent of all the catalytically cracked aviation base stock produced in the United States. Eleven more Houdry catalytic cracking units now are under construction and as rapidly as possible will take their place as sources of supply for aviation fuel. In addition, nine Thermofor catalytic crackers, embodying a catalytic cracking process also licensed by Houdry Process Corporation, are being rushed to completion.

Immediately after Pearl Harbor, the petroleum chemists and engineers of the Houdry organization concentrated their efforts on finding a method for producing the raw materials of synthetic rubber. Out of that came the Houdry butadiene dehydrogenation process, the basis for four plants now being built by the government. The first of these plants is scheduled to be completed early this spring.

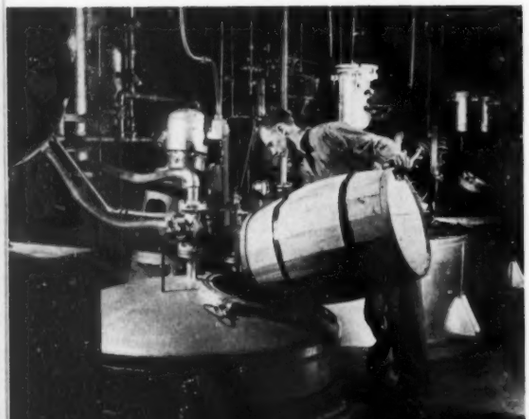
Meanwhile these experts in research have conducted extensive experiments into methods of producing other rubber intermediates besides butadiene. In order to improve the quality of Buna S rubber, the Houdry laboratory has worked to develop new polymerization methods. More than 600 polymers have been made in an effort to discover a coordination of factors which would most effectively contribute to uniformity in the production of synthetic rubber imparting high tensile strength, elasticity, elongation and low heat build-up. Although nothing definite about the results of these experiments can be revealed now they have been sufficiently encouraging to convince the chemists that they are on the right track.

During the past year work also has been done, in cooperation with the engineers of the Socony-Vacuum Oil Company, in adapting the Houdry process to the production of ethyl benzene and on the dehydrogenation of ethyl benzene to styrene, the other important ingredient of Buna S rubber. During 1942 the Houdry Process Corporation doubled its facilities for the production of synthetic catalyst. This program was launched in 1941 in anticipation of the increased demand for aviation gasoline.

PROGRESS OF RUBBER PROGRAM

Threatened by Diversion of Materials

Proposal to Defer Part of Plant Construction Authorized Meets Conflicting Opinions—Full Public Explanation of any Such Step Is Urged



Worker mixing a solution in a nickel-lined tank for the manufacture of synthetic rubber. Official OWI photo.

RUBBER may well be termed the stormy petrel of American war production. Certainly no part of the vast and far reaching group of plans for marshaling the country's fighting strength and extending aid and support to its allies has been the subject of more controversy or has undergone greater vicissitudes than has the projected replacement by synthetic products of the natural rubber supply cut off by Japanese conquest of the East Indies and the Malay States.

Now rubber is again in the limelight of Washington debate. This time it is not because of disagreement as to the merits of various source materials nor because of anticipated failure of the plans adopted. It is rather a question of determining the most effective employment for the winning of the war of certain basic materials of which steel is the most conspicuous and quantitively the most important. We have passed beyond the point where we can count on the production of everything required for military or civilian use in whatever quantity and have entered the stage where decision must be made as to what we can do without with least possible impairment of our fundamental objective—the prosecution of the war to a successful finish. This decision necessarily must be applied to an increasingly broad range of products and activities as the war grows in intensity. At this moment some millions of Americans are doing with less heat in their homes, less gasoline for their cars and shorter supplies of many other things in order that more materials and equipment may be sent to our own fighting forces or to sustain the strength of allied nations.

As to the principle involved there is no dispute but in dealing with matters of necessity there obviously is room for divergence of views as to which of several needs are the more imminent. Wars are waged by men and machines. To train, equip and supply the fighting forces wherever they may be located is a primary obligation. Transportation facilities limit the number of men who can be moved to the battle areas and maintained there. Since every front in which America is interested is thousands of miles distant from her own shores military officials are constantly demanding not only arms and ammunition but more and more ships to move men and supplies to the scene of action. Ships of many kinds are needed—cargo ships, transport vessels, cruisers, destroyers and sub chasers to protect the merchantmen from deadly U-boat attack. Of what use is it, say the advocates of greater concentration on ship construction, to manufacture even such essentials as arms and munitions if they cannot be moved to the places where they are needed or are sent to the bottom of the sea because of lack of protection en route.

On the other hand those who have been charged with the task of production to meet war needs feel an obligation to carry out their assigned tasks in full measure and they very properly contend for the materials and facilities to fulfill their particular parts of the general program. If there is a discrepancy between the total quantity of materials available and the sum of the demands of different chapters of the war production program some adjustments must be made to bring the two into balance. This is the situation that has required frequent revisions of production plans, the rearrangement of material allotments for industrial purposes and sometimes requires the suspension of projects on which a considerable amount of work already has been done.

This is the possibility that now confronts the synthetic rubber program and that may defer completion of some of the plants that have been authorized and on which construction has been started. Should this be necessary it would affect the time table set up for provision of the basic materials of rubber fabrication and consequently would defer the date when a full supply of tires and other rubber equipment would be available.

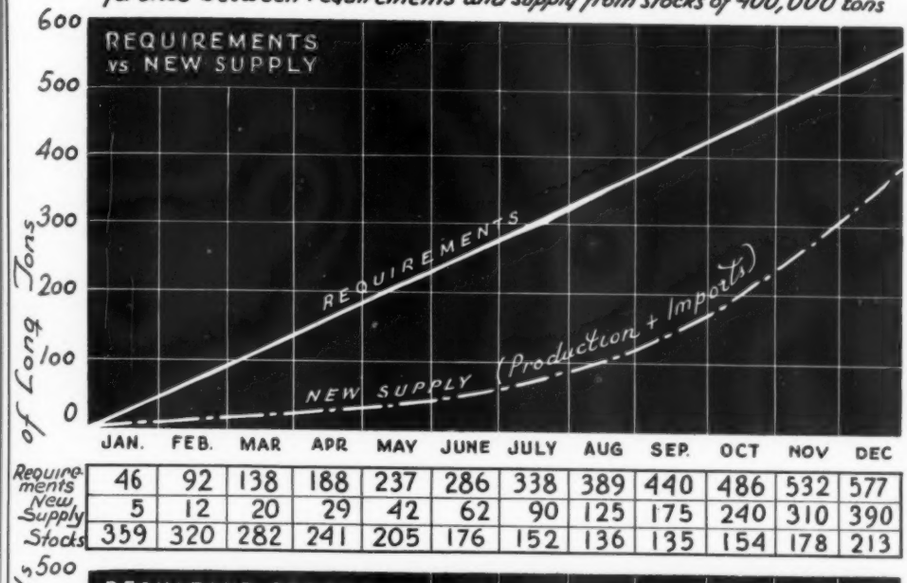
In arguing for a deferment of some portion of the synthetic rubber program in order to use the materials thus released for other pressing war demands the military authorities offer their cooperation to the extent of cutting down their own demands by approximately 20 percent and express the belief that the other allied nations receiving rubber under lend lease can be induced to effect similar savings. This would reduce total requirements this year and next by approximately 200,000 tons. In the opinion of members of the Rubber Director's staff, however, the proposed cut in critical materials to be assigned to plant construction would reduce capacity by 45 percent, bringing it down from 947,000 tons to approximately 520,000 tons so that the amount available for essential needs within the country would be lowered by 300,000 tons. So drastic a cut, they contend, would interfere seriously with industrial activity within the country and would react upon the productive capacity of manufacturing plants engaged in production for war needs. Moreover they dislike to see a narrowing of the margin between estimated production and actual requirements because of possible delays in construction or difficulties in bringing into full and smooth operation plants in which new processes and equipment are being installed.

From the time of his appointment Rubber Director William M. Jeffers has adopted as the charter for his guidance and has proceeded on the policy of carrying out to the letter the recommendations set forth in the report of the Baruch committee which investigated the whole rubber situation in the summer of 1942. The committee proposed that the plans and projects already approved by Rubber Reserve be carried through to completion and that they be supplemented by an increase of 100,000 tons a year in butadiene production through a refinery conversion plan that had been worked out about the time when its investigation started and by certain other small additions to provide opportunity for trying out other processes that had been suggested. The most important of their recommendations in this respect was the addition of 140,000 tons of Buna S. rubber to the quantity previously provided for.

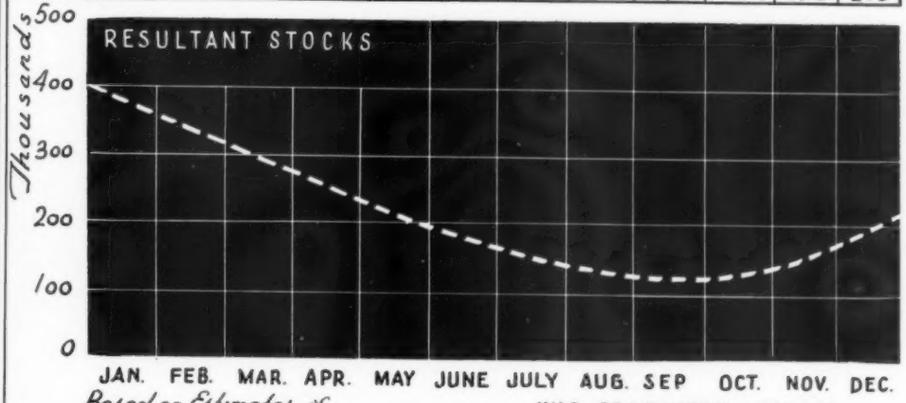
1943 U.S. SUPPLY OF RUBBER vs. ESSENTIAL REQUIREMENTS

Crude and/or Synthetic in terms of Equivalent Crude

NOTES 1. *Reclaimed rubber and Buna N not included* 2. *All data are on a cumulative basis.* 3. *Resultant stocks obtained by subtracting difference between requirements and supply from stocks of 400,000 tons*



	JAN.	FEB.	MAR	APR	MAY	JUNE	JULY	AUG	SEP.	OCT	NOV	DEC
Requirements	46	92	138	188	237	286	338	389	440	486	532	577
New Supply	5	12	20	29	42	62	90	125	175	240	310	390
Stocks	359	320	282	241	205	176	152	136	135	154	178	213



Based on Estimates of NOV. 25, 1942 *Progress Report Number One*

WAR PRODUCTION BOARD *Office of Rubber Director*

In accordance with these suggestions the Defense Plant Corporation has let contracts to 45 corporations and companies for the erection of 67 factories to produce four types of synthetic rubber. The total cost of these factories is estimated to exceed $560,000,000. The types of synthetic rubber to be produced and the quantities thereof in long tons per year are shown in the accompanying Table I. The government financed butadiene plants that are to produce butadiene, which is the principal component of Buna S. rubber, are listed in Table II. In addition, butadiene will be produced by the companies listed in Table III, which have converted part of their ordinary equipment for the purpose. The 67 contracts for production of the four rubbers are listed in Table IV. The styrene (200,000 to 250,000 tons) is being made by four chemical companies: Dow Chemical Co., Monsanto Chemical Co., Carbide and Carbon Chemicals Corp., and Koppers United Co. Styrene and minor ingredients for compounding are not affected by the difficulties that attend the production of butadiene.

TABLE I

Planned Yearly Synthetic Rubber Capacity

Type	*Tons*
Butadiene-Styrene Copolymer	705,000
Butly rubber	132,000
Neoprene	60,000
Thiokol	50,000
Total	947,000

More recently the capacity goal has been set at 1,100,000.

Such is the program. If and when realized, it will cover all essential military and civilian needs of the United States and the major lend lease requirements.

As was pointed out by the Baruch committee the full program for butadiene production could not be put into operation before 1944 and the critical period in the matter of rubber supply could be expected to occur during the final quarter of 1943 when reserves probably would be reduced to as low a level as they could safely be permitted to reach. Its recommendations as to tire conservation were based on the necessity of tiding over this period in the expectation that inception of the full program of production early in 1944 would permit the release of rubber for more liberal civilian use in addition to supplying anticipated military needs. But the committee reiterated throughout its report that this expectation could be realized only if the flow of materials to the fabricators of plants were kept up in full scheduled volume and they intimated some doubt even at that comparatively early stage as to whether this would or could be done. Mr. Jeffers, in numerous statements since he assumed his present post, has declared with some vehemence that it was not being done and that the program as set up and approved was being imperiled by the lag in deliveries.

This is the crux of the present situation. If needed materials can be delivered on time there is no doubt that the projected capacity to produce synthetic rubber can be put into operation as scheduled. The research has been done. The theoretical and the practical basis for the production of satisfactory substitutes for natural rubber has been laid. The technical problems have been solved. The technologists have learned all they need to know at present from the pilot plants and small synthetic rubber factories that have been in existence for a considerable time. It remains only to build and equip the plants now authorized and to set them to work. Unless materials for the plants can be supplied with greater rapidity, the Rubber Director points out, the whole program will be set back and the relief promised to users of rubber will be seriously delayed.

Even under the most favorable circumstances with all necessary construction materials available on the spot, a full equipped plan for making butadiene (which is the principal ingredient of the butadiene-styrene copolymer) can hardly be erected in less than a year's time. Only a small fraction of the planned capacity to produce butadiene is at this moment delivering the goods. Construction of some of the 67 plants has just been started, and work on many others is still far short of completion.

Two small plants are now producing and delivering butadiene enough to make 15,000 tons of synthetic rubber a year. Some larger ones will come into action in February, others in March, and later on still more will follow until, some

Standing on a "blow down" tank, this man is about ready to tap a polymerizer tank. The latex blended in the latter tank is stabilized in the "blow downs". A large blending tank increases the uniformity of these synthetic solutions by mixing the contents of seven or eight of these tanks. Official OWI photo.

time in 1944, the total capacity for 1,100,000 tons a year will be reached.

Meanwhile, the stockpile will be shrinking. At the end of 1942 it was approximately 400,000 long tons, and getting smaller by the month. As the year 1943 opened a trickle of synthetic rubber was flowing into the pile and the question is, will the trickle swell and overtake the rate of consumption before the downward curve of residual stock "kisses" the danger point of the 120,000 ton inventory?

The expected relation between decrease of inventory and increase of production during 1943 is shown in the accompanying chart: "United States Supply of Rubber vs. Essential Requirements," issued by the Office of Rubber Director Jeffers. In the top half of the chart, the rate at which the stockpile will be consumed is shown by the solid line, and the rate at which the pile will be replenished is shown by the broken line. For more than half the year the outgo will exceed the input, and the rate of input will not overtake the rate of outgo until some time in the fall, presumably by the first of October. The actual state of the stock pile at various times is indicated in the lower half of the chart, which also shows October 1 as the danger point.

This danger point is not a figment of the imagination. The Baruch report definitely found that the domestic inventory of rubber stocks cannot be allowed to fall below 120,000 tons at any time. This irreducible minimum is represented by a 30-day inventory for American manufacturers, a 4,000-ton inventory for Canadian manufacturers, and at least 66,000 tons as a necessary inventory on hand in Great Britain to protect against interruption of Atlantic transportation. It is considered that at least 100,000 tons of this inventory should be in the form of crude natural rubber to protect those requirements of the military needs that can only be met by the use of natural rubber. The Rubber Director indorses this finding of the Baruch Report, with the reservation that it is perhaps too much on the short side. The Rubber Director has repeatedly insisted that the program will be fulfilled if it is not interfered with by circumstances, which he has carefully specified, that are beyond his control. To a minor but significant degree, replenishing the stockpile depends on imports of natural rubber from the areas not under Axis control. Toward the close of 1942 these imports were estimated to average 3,000 tons a month; exact figures are not given out. Some persons in the rubber trade have estimated that Ceylon, British India, Africa, South America and Mexico can deliver natural rubber at the rate of 233,000 tons a year. If the United States could get even half of this it would do much to keep us out of danger. But the scarcity of transportation plus the activity of Axis submarines, may indefinitely reduce these prospects. There has been much talk of new plantations of guayule, Russian dandelion and other rubber-yielding growths, but these cannot enter the picture until late in 1944 and after.

Another circumstance that is causing the Rubber Director a great deal of worry is what he has described as the failure of the general public to understand that it is essential to our war effort, and that it is the plain duty of the Rubber Director, to keep on the roads that portion of our essential transportation system which is dependent on public and private motor vehicles.

"They do not understand the vital importance of making their present tires last," he says. "It seems as though most people have not yet got it into their heads that the vast majority of our motor vehicles must run from now until the middle of 1944 on the tires now in use. Lacking this understanding, people have resented gasoline rationing and probably will continue to resent it until they have been brought to see its real purpose, which is to reduce driving and thus save wear and tear on their tires. Unless those tires hold out until the synthetic rubber program gets into full swing the result will be both private and public disaster." The Rubber Director evidently has strong feelings on this point; he is appealing to all authoritative agencies to help in driving the lesson home. It is particularly desirable to dispel the erroneous notion that recently issued regulations for tire control assure that tires of one kind or another will become available to all who need them.

Granted that the public can be induced to refrain from needlessly destroying the rubber which it has, and granted that the new plants to manufacture butadiene are completed on schedule, the synthetic rubber program will be solved. But the assumption that it will be solved by the beginning of 1944 is an unsafe one to make. In view of shifting war conditions and expanding war demands it appears extremely unlikely that a liberalization in the civilian use of rubber will be possible by that time. That is a contingency of which the public should be fully informed to avoid complaint and clamor later. Important though it is, the synthetic rubber program is not the only component of the general war effort. There are other "musts," such as the aviation gasoline problem, for instance. Airplanes must have rubber tires, and pilots who fly over water must have collapsible rubber boats and other gadgets, but they must have 100-octane gasoline also. Trouble comes from the fact that the aviation gasoline program and the rubber program both make demands on the same raw materials, and both require the same essential construction and engineering materials out of which to build the necessary facilities for manufacturing. If it were only a matter of making rubber, or only of making aviation gasoline, there would be little trouble, but both have to be made now, and there is scarcely enough raw chemical material and materials for construction to go around. And rubber and aviation gasoline are not the only "musts". Hundreds of essential war needs demand steel, for guns, for ships and for many other things, but especially for ships, and more particularly for escort vessels to combat Axis submarines, so that war materials, including rubber and gasoline, can be delivered on the sixty battlefronts.

It is this competition among different needs, all of seemingly equal urgency, that is providing the Rubber Director with one of his principal worries. The War Production Board has other clamorous clients, and feels itself obliged to distribute priorities in an effort to maintain balance among all. Director Jeffers is confident that if he could get AAA priorities for plants covering 65 to 70 percent of the synthetic rubber program he could safely guarantee that rubber would be produced at the rate of 600,000 tons a year at the beginning of 1944. This would keep the military machine rolling, but would at that time provide no new rubber for civilians, who would have to get along with such reclaimed rubber and recapping material as may then be available. To make an appreciable contribution to civilian needs it will be necessary to bring the program 100 percent to completion, and not merely 70 percent.

So far, the War Production Board has granted AAA priority for only 20 percent of the synthetic rubber program, about the same that has been accorded to the 100-octane gasoline pro-

TABLE II

Government Butadiene Plants, Including Purification Equipment
By Thermal Cracking of Mixed Petroleum Hydrocarbons

Contractor and location—	Est. cap'y short tons
Shell Chemical Co. and Southern California Gas Co., Los Angeles, Calif.	85,000
Atlas Refining Corp., Shreveport, La.	10,000
Standard Oil Co. of La., Baton Rouge, La.	8,300
Carbide & Carbon Chemicals Corp., Charleston, W. Va.	5,000
Subtotal	108,300
By Catalytic Dehydrogenation of Butylene and Mixed Butylene and Butane	
Humble Oil & Ref. Co., Baytown, Tex.	30,000
Standard Oil Co. of La., Baton Rouge, La.	15,000
Neches Butane Products Co. (2 plants), Port Neches, Tex.	100,000
Sinclair Rubber, Inc., Houston, Tex.	50,000
Cities Service Ref. Co., Lake Charles, La.	55,000
Subtotal	250,000
By Catalytic Dehydrogenation of Butane	
Phillips Petroleum Co., Borger, Tex.	45,000
Sun Oil Co., Toledo, Ohio	15,000
Subtotal	60,000
Total butadiene from petroleum	418,300
From Alcohol by Carbide Process	
Koppers United (4 plants), Pittsburgh, Pa.	80,000
Carbide & Carbon Chemicals Corp. (plants), Louisville, Ky.	60,000
Carbide & Carbon (4 plants), Institute, W. Va.	80,000
Total butadiene from alcohol	220,000
Total of government-owned butadiene plants	638,300

TABLE III

Authorized Refinery Conversion Butadiene Projects January 4, 1943

Company	Location	Capacity Tons Per Yr.
Authorized Before Baruch Report		
Atlas Oil & Refiining	Shreveport, La.	8,000 to 10,000
Sun Oil	Toledo, Ohio	15,000
Standard Oil of Louisiana	Baton Rouge, La.	6,860
		3,500
Authorized After Baruch Report		
Arkansas Fuel Oil	Bossier City, La.	6,700
Lion Oil Refining	El Dorado, Ark.	12,800
Eastern States Petroleum	Houston, Tex.	8,000
Pan American Petroleum	Texas City, Tex.	10,000
Humble Oil & Refining	Ingleside, Tex.	7,000
Taylor Refining	Corpus Christi, Tex.	5,500
Standard Oil Co. (Indiana)	Wood River, Ill.	41,000
Ohio Oil	Robinson, Ill.	3,500
Magnolia Petroleum	Beaumont, Tex.	15,000
Standard Oil Co. of California	El Segundo, Calif.	15,000

gram. In view of this limitation the Rubber Director is doubtful whether his production curve will avoid falling below the 120,000-ton inventory deadline next fall. Untoward circumstances, that delay construction of the plants, or that obstruct production after they have been completed, will have serious consequences unless steps are taken to conserve existing stocks before that deadline is reached.

On the main point involved in the present discussion over revision of the rubber program it is worth while quoting one salient paragraph from the Baruch Report. The committee said: "The military men must decide what things come first in war production, but it is the duty of the Committee to point out that unless the flow of materials for the construction of these synthetic rubber plants is insured there will be no rubber in the fourth quarter of 1943 with which to equip a modern mechanized army."

If now the military men decide that they can reduce the draught of the Services and of Lend-Lease upon existing stocks so that this condition will not arise and if they are convinced that a postponement of part of the rubber program is made necessary by developments on the war fronts such an adjustment will have to be made. But Rubber Director Jeffers is right in asserting that any such situation must be explained to the public and that responsibility for it must be assumed by someone in whom the public has confidence.

TABLE IV

Synthetic Rubber Contracts

Company	No. of Plants
American Car & Foundry Co.	1
Atlas Oil Co. of La.	1
Barium Reduction Corp.	1
Buffalo Electro Chemical Co.	1
Carbide & Carbon Chemicals Corp.	4
Cities Service Oil Co.	1
Consolidated Oil Corp.	1
Copolymer Corp. (A)	1
Crown Central Petroleum Co.	1
Davison Chemical Co.	2
Dow Chemical Co.	4
Eastern States Petroleum Co.	1
E. I. duPont de Nemours & Co.	2
The Ethyl Corp.	1
Filtros, Inc.	1
The Firestone Tire & Rubber Co.	3
General Synthetic Co. (B)	1
The B. F. Goodrich Co.	4
The Goodyear Tire & Rubber Co.	4
Hancock Oil Co. of Calif.	1
Humble Oil & Refining Co.	2
Koppers United Co.	2
Magnolia Petroleum Co.	1
Monsanto Chemical Co.	1
National Synthetic Rubber Corp. (C)	1
Neches Butane Products Co. (D)	1
Pacific Gas and Electric Co.	1
Pan American Petroleum Co.	1
Phillips Petroleum Co.	1
Publicker Commercial Alcohol Co.	1
Quaker Oats Co.	1
Q. O. Chemical Co.	1
Shell Chemical Co.	1
Sinclair Refining Co.	1
Sinclair Rubber, Inc.	1
Southern California Gas Co.	1
Southport Petroleum Co.	1
Standard Oil of Cal.	1
Standard Oil Co. of Ind.	1
Standard Oil Co. of La.	3
Sun Oil Company	1
The Thiokol Corp.	1
The United States Rubber Co.	3
Ugite Sales Corp.	1
Westvaco Chlorine Products Corp.	1

(A) Copolymer Corporation owned by: Armstrong Rubber Company, The Dayton Rubber Manufacturing Company, The Gates Rubber Company, Mansfield Tire and Rubber Company, Lake Shore Tire and Rubber Company, Pennsylvania Rubber Company, and Sears, Roebuck and Company.

(B) General Synthetic Company owned by: The Seiberling Rubber Company, General Latex and Chemical Corporation, The General Tire and Rubber Company, Jenkins Brothers and Dunlop Tire and Rubber Corporation.

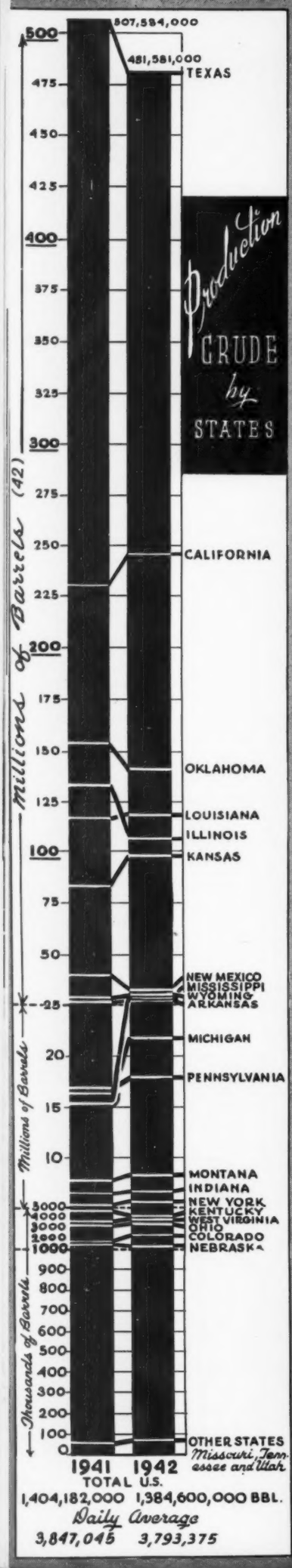
(C) National Synthetic Rubber Corporation owned by: Hewitt Rubber Corporation, Lee Rubber and Tire Company, Hamilton Rubber Manufacturing Company, Goodall Rubber Company, Inc., and Minnesota Mining and Manufacturing Company.

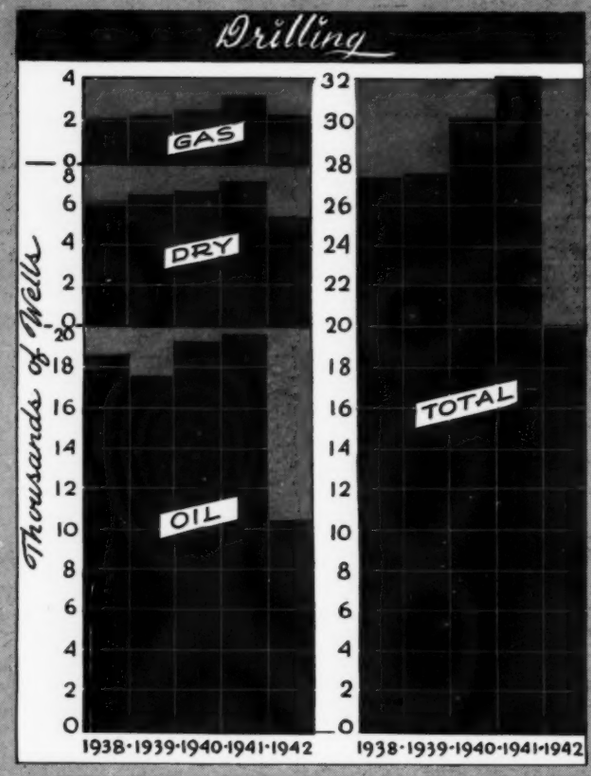
(D) Neches Butane Products Company owned by: Atlantic Refining Company, Gulf Oil Company, Pure Oil Company, Socony-Vacuum Company and Texas Company.

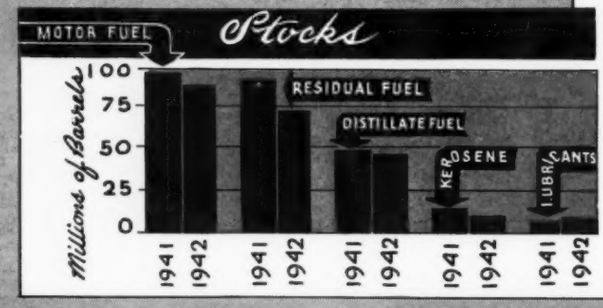
Sheet of synthetic rubber as it comes off the rolling mill. Official OWI photo.

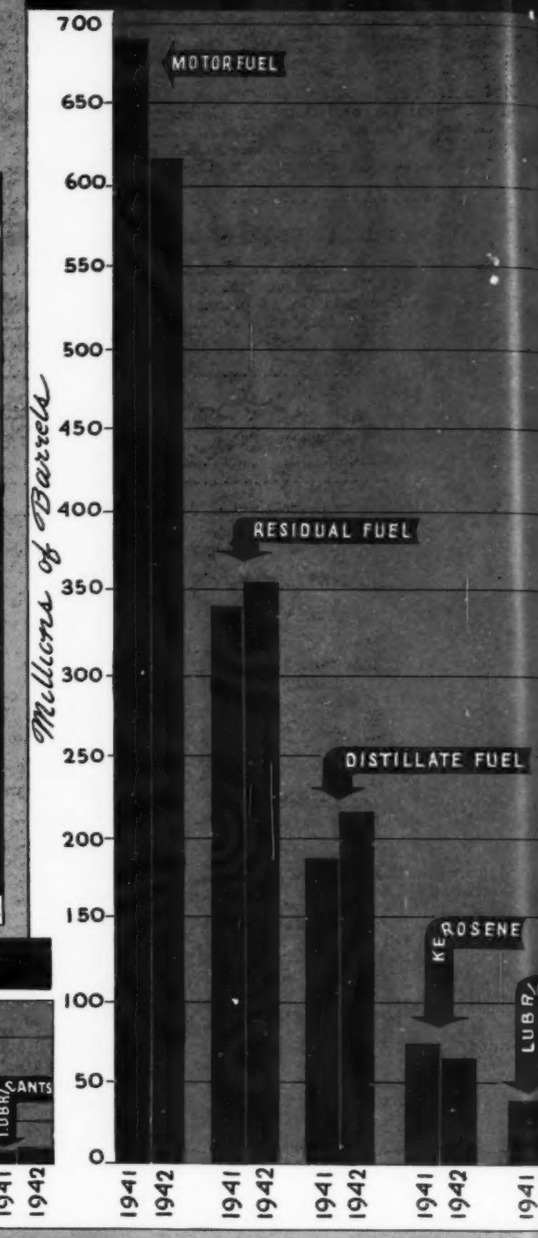
1942 Record of OIL INDUSTRY

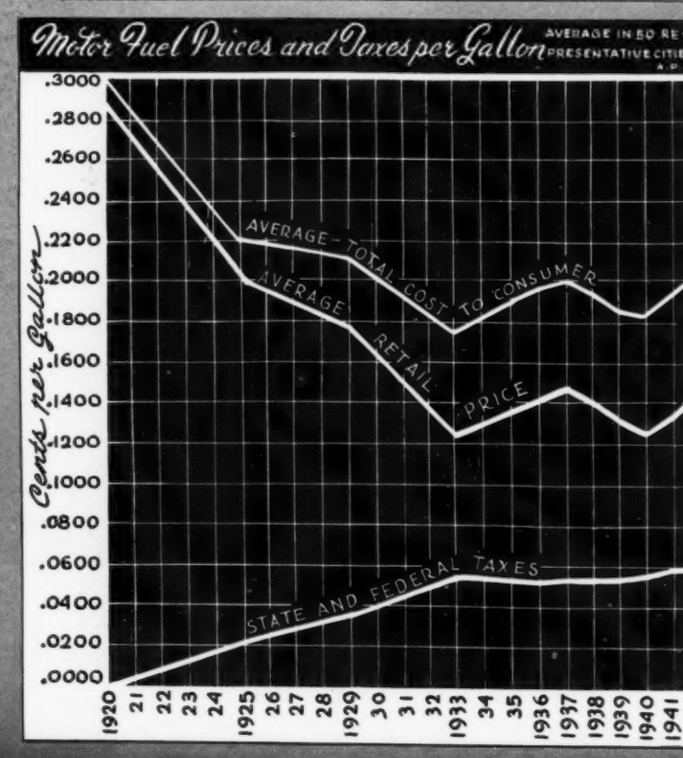
Based on Year-end Statement
by WILLIAM R. BOYD Jr.
Pres. American Petroleum Institute

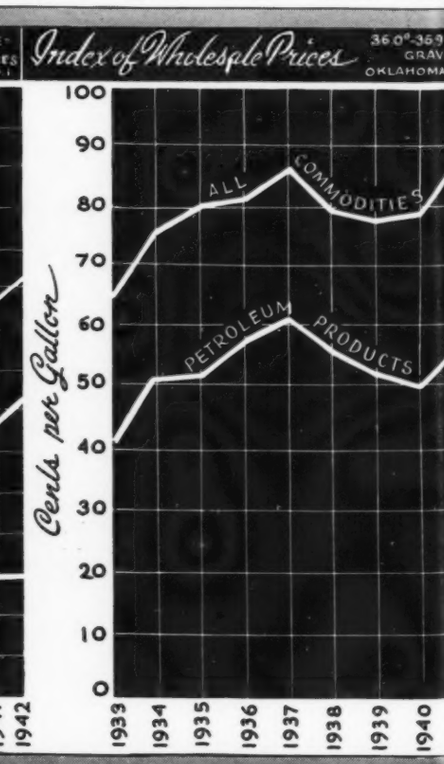









Motor Fuel Prices and Taxes per Gallon
AVERAGE IN 50 REPRESENTATIVE CITIES
Cents per Gallon
AVERAGE TOTAL COST TO CONSUMER
AVERAGE RETAIL PRICE
STATE AND FEDERAL TAXES
1920 21 22 23 24 1925 26 27 28 1929 30 31 32 1933 34 35 1936 1937 1938 1939 1940 1941 1942



U. S. PRODUCED MORE FUEL OIL, LESS GASOLINE IN 1942

In a statement reviewing developments of the preceding twelve months such as usually is given out at the end of the year William R. Boyd, Jr., president of the American Petroleum Institute, touched briefly upon significant events of 1942 affecting the petroleum industry of the United States. Transportation, men, materials and money were the industry's basic problems, he said, and added that they would become more critical before they were solved. Mr. Boyd said that the main task of the oil industry, that of keeping the country's armed forces and those of the allied nations supplied with fuel and lubricants, had been carried through with complete success and he quoted Gen. W. B. Pryon of the War Department to the effect that "not one ship or plane or tank has failed to move on schedule for lack of petroleum products."

"The East Coast has become the front porch of Africa and Europe" said Mr. Boyd in commenting upon the heavy shipments abroad which have aggravated the shortages of gasoline and fuel oil in the Eastern states. Manpower shortages, particularly the loss of skilled workers and technical men to the military services are cited as adding to the operating difficulties of the industry. Financial problems due to changes in refining requirements are mentioned as one of the subjects requiring early attention. "The burden of manufacturing more lower-priced and less higher-priced products in a frozen economy is attacking the solvency of many of the smaller units of the industry and actually is threatening their ability to produce," it is stated.

Statistics accompanying the statement place crude oil production at roundly 1,385,000,000 bbl., a slight reduction (18,600,000 bbl.) from the record output of 1941. Production by states, shown in Table I, record small decreases in Illinois, Oklahoma, New Mexico and Texas with slight gains in other principal producing states. For 1943, it is stated, a substantial increase in crude production is indicated since a rise of 400,000 bbl. daily will be required by the end of the year to meet even the rationed demand as compared with the corresponding priod of 1942.

Total production of motor fuel, kerosene and lubricants decreased from the 1941 levels but the output of light and heavy fuel oils established all time highs. Inventories of all major products except lubricants at the end of the year were substantially below 1941 year end figures. Statistics of products and stocks are given in Table II.

Table I

Crude Oil Production
(In thousands of barrels)

State	1940	1941	1942
Arkansas	25,775	26,327	26,664
California	223,881	230,263	247,775
Colorado	1,626	1,875	2,267
Illinois	147,647	134,138	106,454
Indiana	4,978	6,634	6,758
Kansas	66,139	83,261	97,647
Kentucky	5,188	4,762	4,200
Louisiana	103,584	115,908	116,878
Michigan	19,753	16,361	21,753
Mississippi	4,400	15,314	28,846
Montana	6,728	7,526	8,077
Nebraska	*	1,636	1,286
New Mexico	39,129	39,369	31,931
New York	4,999	5,185	5,410
Ohio	3,159	3,340	3,575
Oklahoma	156,164	154,759	140,106
Pennsylvania	17,353	16,750	17,940
Texas	493,209	507,584	481,581
West Virginia	3,444	3,433	3,575
Wyoming	25,711	29,694	31,794
Other States**	347	63	65
U. S. Total	1,353,214	1,404,182	1,384,582

* Included in Other States in 1940.
** Missouri, Tennessee, and Utah in 1941 and 1942; these states and Nebraska in 1940.

Table II

Production and Stocks of Principal Petroleum Products
(Barrels)

Product	Production		Stocks—Dec. 31	
	1942	1941	1942	1941
Motor Fuel	614,350,000	690,958,000	87,000,000	98,119,000
Kerosene	65,900,000	72,586,000	10,000,000*	14,515,000*
Distillate Fuel Oil	215,200,000	189,177,000	45,000,000	49,330,000
Residual Fuel Oil	355,400,000	342,367,000	70,000,000	93,138,000
Lubricants	38,500,000	39,539,000	10,000,000	8,127,000

* Includes terminal stocks.

Table III

Wells Completed in the U. S.

Year	Oil Wells	Gas Wells	Dry Holes	Water-Drive Wells	Total
1938	18,598	2,066	6,141	688	27,493
1939	17,625	2,198	6,474	1,420	27,717
1940	19,125	2,352	6,617	1,947	30,041
1941	19,552	3,007	7,128	2,366	32,053
1942	10,450	2,250	5,500	1,800	20,000

The number of wells drilled during 1942 as shown in Table III fell off 25 percent as compared with 1941 while there was an increase in the proportion of dry holes and the number of producing oil wells brought in declined by 46.5 percent. These results give point to the statement in the report that "new oil reserves are needed at once, and studies are being made by the Petroleum Industry War Council and others to determine what incentives ought to be granted to encourage new discoveries of oil."

In the absence of dependable information from many areas no accurate compilation of world production of oil during 1942 is possible but estimates based upon a knowledge of conditions in different territories point to a probable output of 1,935,000,000 bbl., as compared with 2,172,000,000 bbl. in 1941, a decrease of approximately 11 percent.

In the world picture the most striking change was the virtual elimination of the entire production of Netherlands Indies, British Borneo and Burma aggregating some 78,000,000 bbl. All these territories were overrun by the Japanese during their drive to the South Pacific during the early months of 1942. In all of them it was reported refinery and storage installations were destroyed and producing wells were plugged or blown up, putting them out of commission either permanently or for a considerable period. Statements emanating from Japanese sources have asserted that the invaders were engaged in new drilling and rehabilitation of wells in several areas and that they were obtaining large supplies for shipment to Japanese refineries. In circles well informed regarding conditions in the East Indies it is not considered probable that more than a fraction of the normal production of this area is being obtained.

Production in certain countries, including Venezuela, Colombia and Mexico, has been reduced because of the lack of adequate shipping facilities. In Iraq it was restricted to the capacity of one branch of the pipe line to the Mediterranean. In other districts so situated that their output could be utilized in military operations of the United Nations substantial increases have taken place.

Only fragmentary information has reached the outside world regarding conditions within Nazi dominated Europe. It is known that a number of new wells have been brought into production in Hungary and these are said to have raised production there to around 5,000,000 bbl. Italian authorities claim that the output of Albanian fields has been increased to over 2,000,000 bbl. Conflicting statements have been made as to the expansion of natural and synthetic production in Germany. In spite of the efforts of Nazi authorities to bring about larger production in Poland and Rumania both these countries are believed to have registered substantial declines. On the whole European production, aside from synthetic, probably has undergone no increase.

Owing to the tremendous rise in war demands for petroleum products and the disruption of normal transportation facilities the consumption of petroleum products by the civilian population has been greatly restricted even in countries that produce much more oil than they consume. This is a condition that may be expected to continue until the conclusion of the war.

Chief Patrol Officer Floyd Story shown putting Lady over the jump as part of her advanced training.

DOGS OF WAR
Are Doing Their Bit in NATIONAL SERVICE

Canine Commandos Are Being Used by the Army and Industrial Concerns to Share in Guard and Patrol Duties — Continental Oil Company Employs Historic Breed of Fighters to Protect Its Properties

A NOTEWORTHY but little publicized section of the country's military forces consists of its canine members. They have been enlisted in large numbers by the Army, Marine Corps and Coast Guard for sentry, scouting and patrol duty. They are drawn from many classes of the dog population and are not confined to any single breed though great danes, police dogs, airedales and some of the bull breeds are considered especially suitable for the work required. Most of the dogs admitted to the service come from private owners, many of them through a civilian organization called Dogs for Defense which has promoted the work by sending out questionnaires to dog owners and acting as a volunteer procurement agency.

The dogs selected as suitable candidates for service are given a careful examination to determine their physical health and aptitude for wartime work. They then enter upon a period of special training which develops the soldierly qualities of discipline, prompt obedience to commands and knowledge of when and how to attack. An important phase of the training is familiarizing them with the men whom they are expected to accompany while on duty. Close understanding and friendship between men on scouting, patrol or sentry duty and their canine companions is essential to satisfactory team work.

Aside from the direct employment of dogs in purely military operations they are rendering valuable service in many parts of the country in guarding public and private property against possible destruction or damage by sabotage. An interesting example of the training and use of canine assistants to the armed guards employed to protect the properties of Continental Oil Company is provided in the following account. The special attention given by the company to the development of its four legged auxiliary police has resulted from the interest of President Dan Moran in the particular breed which historically has been highly adept both in offensive and defensive action for the protection of the lives and possessions of those whom they serve:

Fifty years before the Christian era—when the Romans were invading the shores of England—huge Mastiff dogs, so called because of their size, played a vital part in the battles of the day. So important were the beasts that the hordes of Roman soldiers which over-ran the British Isles considered them prize captives. "A British dog is worth three soldiers," the conquerors told their fellow Romans and Mastiffs thereafter were enrolled as a part of the Roman legion.

Today the direct descendents of the English Mastiff—the cross-bred Bullmastiff, 60 percent Mastiff and 40 percent Bulldog, are still carrying on in a wartime role. They are playing an important part in preventing other invading hordes from over-running not only the British Isles but the entire peace-loving, decent living world.

Not all the Bullmastiffs, however, are on the battlefields. Many are needed at home to guard the lives and property of the American industrial army. As a part of Continental Oil Company's vast protective program, seven Bullmastiffs—Duke, Salt, Jodie, Jill, Judy, Gal and Lady—are on sentry duty at the company's Ponca City refinery, designated as the breeding and training kennels for more dogs to serve other company properties. Dogs already have been assigned to refineries at Lake Charles, Wichita Falls and Denver; others will soon be ready to go on guard elsewhere.

Training the Bullmastiff is a painstaking task, one well worth the effort once the dog learns what is desired of him, namely, to work night patrols with Continental's armed guard. For that job he must know how to heel, to stand to respond to "come on" and "come at" commands, how to attack the saboteur and to hold the snooper until his patrol master and other guards handle the unwanted prowler in proper fashion.

Breeding stock for these industrial soldiers who wear only a collar and a name-tag for their uniforms was originally imported from England by

President Dan Moran who has privately trained and developed this breed for several years for his personal use. The average Bullmastiff is a powerfully built animal with broad shoulders and tapering hindquarters, smooth, short, fawn-colored hair, v-shaped pendant ears, strong jaws, a long, swooping tail, a pair of dark, friendly eyes which become serious and calculating until they distinguish between friend and foe. The shoulder of the animals is approximately 26 inches for the female and 28 inches for the male. The female weighs around 100 pounds; the male 125 pounds. These industrial watchdogs have strength and courage, the same characteristics which made their Mastiff ancestors famous as war dogs and lion fighters. In temperament the Bullmastiff is gentle and docile to friends, ferocious to enemies. The Continental sentry dog is a perfect physical specimen, must be to pass the veterinary's rigid physical examination.

The dogs spend most of the daylight hours resting in kennels or in exercising and training. They eat only twice daily, and their diet is outlined by canine food authorities. They get the necessary calories and minerals; twice weekly their meal includes fresh meat, cod liver oil and cereals.

Meal times for the Bullmastiffs are 8:30 a.m. and 4:30 p.m. The afternoon meal is light, to avoid giving the dogs a sleepy feeling and to encourage the hunting spirit in the animal. A hungry dog is better able to sense the prowler than one with a satisfied appetite. At nightfall the dogs go on duty at various patrol stations; each one accompanies an armed guard.

Continental Oil Company's armed patrol, as well as the Bullmastiff kennel, is under the supervision of Joe S. Boylan, superintendent of the Safety and Sanitation Division. Floyd Story is Chief Patrol Officer. Nineteen armed guards make up the patrol at the Ponca City refinery. These men are responsible for protection of the property and the safety of 2,000 employes in the area. They are a picked body, necessarily so in view of their duties. The average guard is 5 feet 11 inches tall, weighs 180 pounds. Despite his 40-year-average age he is agile and strong. He learns discipline and order by doing military drill in the company's own gymnasium. An officer of the United States Provost Marshal's office periodically inspects this training to see that it is properly done. Before a man is selected as a guard he is thoroughly investigated by the Federal Bureau of Investigation. Good character is essential; good physical condition a must.

The training program for the armed guard is complete. He learns to fire a pistol accurately, to handle a sub-machine gun, to use disarmament and defense methods both with and without the aid of his Bullmastiff, to detect sabotage, to report anything dangerous to plant or personnel. Each guard must take the oath of allegiance to the United States. He is then commissioned a deputy sheriff with full authority to enforce the law. All guards carry side arms and wear the badge of office.

Assisting the armed guards in Continental's alert watch over its property and personnel is a third group, the gate watchmen. Thrills may not be as plentiful for the gatemen, but their work is important since they form the first line of defense. Theirs is the job of stopping the bolder fifth columnist who might attempt to march through plant gates with our own industrial soldiers. Fifteen watchmen are ready for any such invader; no one passes without complete identification, not even President Dan Moran.

All trucks or other vehicles entering plant gates are inspected and their contents checked. Refinery visitors are few and far between during these war times and those who are permitted to enter are investigated before passes are issued. Those not actually employed by the company must be accompanied by armed guards, even though they may be on bona fide business missions.

Below: Lady on the search for prowlers.

The Bullmastiff kennels at the Continental Oil Company's refinery where the dogs are trained, and thereafter assigned to various refineries throughout the country to assist in guard duty.

This posed picture shows what would happen if a saboteur tried to tamper with an oil storage tank.

But, to get back to our canine friends. Their primary training was conducted by Harry Schoonover, Houston, a man with many years experience in the training of circus animals. Basic and advanced training has been conducted by Chief Patrol Officer Floyd Story, a veteran police officer who has had much success in training dogs for guard duty.

It is an accepted fact among experts that the dog is a "natural" for sentry duty. Dogs of various breeds have been used in protective duties for centuries. For example, when the King of Sparta found that he was making little progress in besieging the city of Mantineau because provisions were constantly being smuggled into the town through his own lines, the work of ancient fifth columnists, the king ordered the city encircled with dogs. The enemy tried to slip past the animals by offering them bits of food but the dogs remained loyal and the illicit traffic through the king's lines was stopped.

But the task of the modern four-legged sentinel is a bit more complicated than that of his predecessors. He must do more than just watch. Today's dog has a better skilled, more deceptive enemy to combat, one who uses every shrewdness to perform a destructive act. The modern watchdog must meet the enemy on even terms.

"Dogs are like humans," says Harry Schoonover. "They are individuals. General rules do not apply to training all dogs. Each one is different, but it's an iron-clad rule that no one can train dogs who doesn't like dogs."

Bullmastiffs are ready for "school" at various ages. The average age is eight months. At six months the young dogs are still in a puppy stage; but that is the time when a dog is taught to recognize its own name, the first step toward obedience. Later come the lessons in which the dog is taught to heel, lead, attack, follow, stand. Each lesson requires from three to fifteen minutes and the primary training course takes from a month to six weeks.

Upon completion of primary training the Bullmastiffs enter the Ponca City kennels where advanced training is administered by Floyd Story and they are graduated to sentry duty. Here the dogs are trained to range in a zig-zag manner, to circle tanks and buildings, to jump fences or gates in their search, to hold a prowler at bay until the master arrives, or to attack when necessary. Continental Oil Company's Bullmastiff kennels were established in the belief that the dog is as important in Twentieth Century warfare as it was the British armies and Roman legions centuries ago. Subscribing to this belief are the allied Army which has a new K-9 corps which takes training similar to that conducted by Continental. The British government constantly uses dogs and has issued a plea for more dogs capable of performing war duties.

RECOVERING SCARCE ALLOYS FROM USED PARTS

MANUFACTURERS of sub-surface oil well pumps on the Pacific Coast are cooperating in the government's campaign for collecting used seats, balls and companion sub-surface pump parts containing scarce alloys, such as stainless steel, tool steel and nonferrous metals. The drive, initiated by H. M. Kent, chief of the salvage section, Office of Petroleum Coordinator for War, was officially begun on Jan. 1.

The manufacturers have agreed to act as central collection agents and are doing everything possible to inform producers, distributors and supply stores of the drive. They are stressing the urgent need for turning in seats and balls so that scarce alloys will be available for making essential replacement parts. It is being pointed out that the nearer the petroleum industry comes to recovering 100 per cent of its needs as a result of the drive, the more inclined the War Production Board will be to grant 100 per cent of the industry's requirements.

Producers are being asked to turn in all worn parts on hand immediately instead of holding them. To discourage retaining excessive quantities of old parts until a comparable number of new parts are ordered, a "credit" plan has been established similar to the now famous tooth paste tube plan. No monetary credit will be involved but "unit credit" will be given for salvaged parts contributed. Under this plan notations will be made on the balls, seats and other parts turned in by each producer. In effect, this system will allow a producer to secure one new part when needed for every used part for which he has received credit by previous salvage.

Mr. Kent related the necessity for such a drive to the various manufacturers on Nov. 11 and asked for their suggestions. He pointed out that participation in a program of this type was the petroleum industry's patriotic duty. After considering their replies, the following points were proposed as a basis for organizing and conducting the campaign:

Functions of the Manufacturer:
1. To act as a central collection point for all alloyed parts gathered in the drive. 2. To maintain a record of the volume of scrap alloy material recovered in the drive, as a means of augmenting the supply of metals utilized in the manufacture of new parts and to keep the Office of Petroleum Administrator advised periodically of these quantities. 3. To segregate the parts by alloy content, advising the Office of Petroleum Administrator periodically of the quantities on hand so that appropriate steps can be taken by the War Production Board to facilitate the movement of the materials to the proper remelting points. 4. To absorb any costs involved in the collection, segregation and disposition of materials not otherwise recovered in the transaction.

Functions of the Jobber or Distributor:
1. To set up a method of extending "unit credit" to the supply stores for the number of balls, seats, etc., turned in, to apply against future purchases of new balls and seats. 2. To prepare a letter to outlets advising them of the drive, outlining the procedure for conducting it and soliciting their wholehearted cooperation in the program. 3. To arrange for the shipment of scrap parts from the primary collection points (the supply stores) to the central collection points (the manufacturers). 4. To absorb any costs incurred in the collection drive.

Functions of the Supply Store: 1. To act as a primary collection point for worn pump parts containing scarce alloys. 2. To set up a method of extending "unit credit" to customers for the number of worn balls, seats, etc., turned in. 3. To work with jobber or manufacturer in arranging for frequent consignment of worn parts on hand. 4. To encourage by word of mouth and otherwise, the full active cooperation of all producers in this collection drive.

RELATIONSHIP OF PATENTS TO RESEARCH

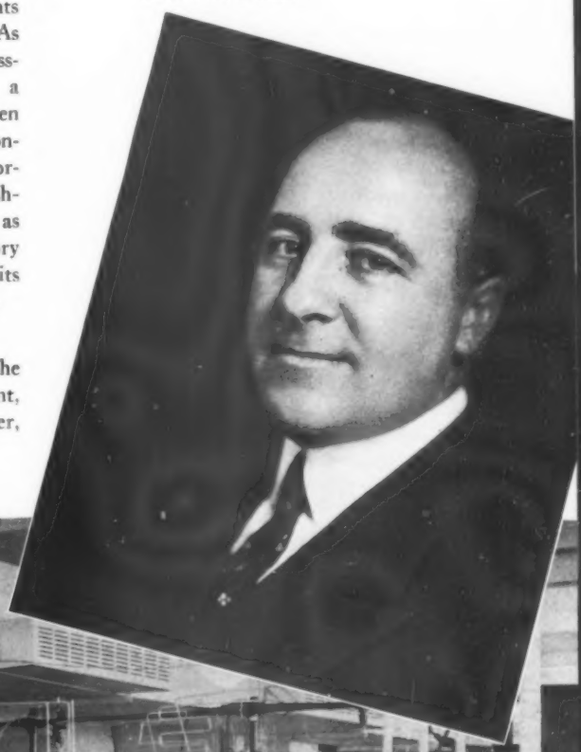
Removal of Patent Protection by Forcing Secrecy for Inventions Would Prevent Disclosure of Information Which Now Provides Stimulus for Improvement of Processes

By Robert E. Wilson

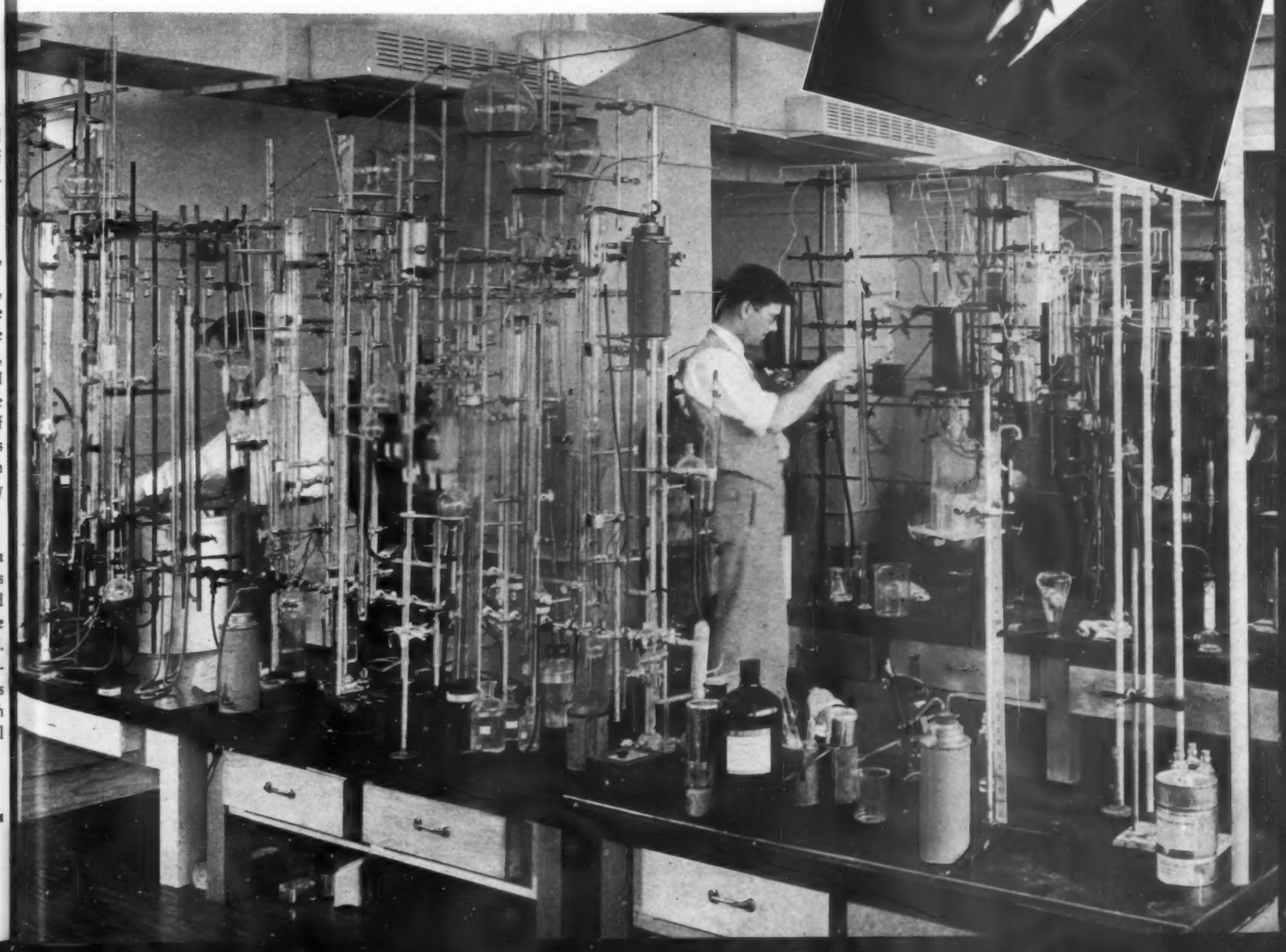
IN MY OPINION the greatest danger to our patent system lies in the lack of clear understanding of the nature of the patent monopoly and the compelling reasons for granting one to the discoverer of a really new product or process. Some of this misunderstanding arises naturally out of the complexity of the situation, but much of it is due to a studied misrepresentation of the essential facts by a small group who have apparently undertaken to destroy or nullify our patent system. One of their outstanding methods of confusing the public has been the old-fashioned one of name-calling. Thus the right to the exclusive use of one's own invention for a limited period, as provided for in our constitution and enacted into law on the recommendation of that great anti-monopolist, Thomas Jefferson, is supposed to be damned by calling it a monopoly. The public traditionally dislikes a monopoly, regarding it as something carved out of the public domain and acquired by an individual. A patent right, however, covers something discovered or created by the individual and is a natural monopoly as long as he can keep it a secret. The patent law simply offers him a legally protected monopoly limited in time in return for prompt disclosure, so that the information is immediately, and all rights eventually are added to the public domain. As another example, a mere exchange of free cross-licenses and technical information between a group of companies engaged in research in a given field is condemned as a "patent pool" or a "monopoly of monopolies." Even the magazine Fortune, evidently under the spell of recent Washington releases, went so far in a recent issue as to picture a patent pool as a jail with laboratory research workers as the prisoners in striped suits and armed guards shooting escaping prisoners.

If an American company, in order to get the right to manufacture under an important patent, granted by our government to a foreign owner,

Dr. R. E. Wilson



* Extracted from address before Society of Chemical Industry on occasion of award to the author of the Perkin medal, Jan. 8, 1943.



Research laboratory of the Phillips Petroleum Company Staff of this laboratory numbers over 150.

had to agree to confine its operations under the patent to the United States, it is charged with participating in a cartel, and if war develops ten years later the company is publicly accused with having conspired with our present enemy to deprive our present allies of needed products. A small inventor is publicly accused before the Senate patent committee of blocking the manufacture of an essential item in airplane equipment by refusing to grant licenses, whereas it shortly developed that the device was not essential, but merely one of several alternative devices, and that the only reason he had not been able to supply his entire demand was that government officials had refused to permit him to buy the necessary equipment to enlarge his plant.

I do not mean to say that patents cannot be, or have not been abused, as rights of every kind can be misused, but I do believe that a deliberate attempt has been made to discredit our patent system in much of the publicity which has emanated from Washington during the past year or two.

As another example of these unfair attacks on patents and inventions consider the public remarks, before this same Senate Committee, of Mr. Thurman Arnold regarding tetraethyl lead. Everyone in the chemical industry appreciates the tremendous economic value of this invention and knows the story of the long and brilliant series of researches by Tom Midgley, which led to the discovery of this anti-knock agent which increased the total available horse-power of the automobile engines made in 1941 by an amount equal to seventy-five Boulder Dams. It was also one of two inventions which made 100-octane gasoline possible. Mr. Arnold, however, airily dismissed it all with the wisecrack, "Now whether these (ethyl) patents were good, I do not know. It struck me at the time, what else could you do with tetraethyl lead but put it in gasoline? You can't put it in coffee."

Such statements by government officials in key positions are particularly dangerous in complex scientific matters which the lay public cannot appraise. The statement would have been less dangerous, though no less unsound, if it had been "Now whether these telephone patents were good, I do not know. It struck me at the time, what else could you do with a telephone but talk over it? You can't play tennis with it."

I hope these various examples are adequate evidence that as scientists we must do our part to educate the public and the lawmakers as to the essential facts about our patent system. As the first step in this educational process we must escape from what Mr. Justice Cardozo has called "The Tyranny of Words" and try to get at fundamental meanings.

A patent is of course a legal monopoly, limited in time, granted by the federal government as a reward, not merely for discovering, but primarily for disclosing to the public the essential facts which would enable another to practice his invention. If he does not make such disclosure the patent is ipso facto void. A patent represents an addition to and not a subtraction from the public wealth. Under our present laws and decisions a patent cannot be used to fix resale prices, to control unpatented articles used in connection with the invention, or otherwise to extend improperly the patent monopoly beyond its limited purview. As a matter of fact, judicial decisions are steadily narrowing the field of what it is permissible to do under a patent. Nevertheless, a patent is a monopoly, is supposed to be a monopoly and should not be considered damned by being called a monopoly.

As a matter of fact a monopoly is not the inherent evil many would have us believe. Indeed, one of the greatest factors in the early development of America was the fact that our settlers could acquire the ownership of land "in fee simple" and thus monopolize forever their land, its products, its minerals, and the improvements which they made thereon. No greater incentive to hard work and self-sacrifice has ever been found than this right of a man to own and control the fruits of his labors. No one today questions the social value and fairness of this monopoly incentive which did so much to extend our geographical frontiers and bring new lands under cultivation. The monopoly granted to the discoverer of a mining claim was likewise largely responsible for the rapid development of our mineral resources. Is it not equally important and valuable to extend our only remaining frontiers, those of science and invention when, to do so, we need only offer a monopoly for a short span of years?

Regardless of theory, the experience of this country during the past 150 years has certainly demonstrated that the American patent system has been an outstanding success. It was based on a sound understanding of human nature and its principles have no more been outmoded than has human nature been outmoded. It has stimulated and supported the natural inventive genius of our people and has resulted in technical and industrial developments which have made us the envy of all other nations. I can speak from close personal knowledge of the stimulation afforded by the outstanding success of the Burton process and the related patent situation. It was unquestionably the major factor in stimulating research in our industry, first on competitive methods of cracking, and then on the myriad of new processes which have transformed the whole industry in recent years. Dr. Burton was in 1912 one of probably not more than a dozen scientists in our whole country engaged in petroleum research. In 1922 when I entered the industry there were about 250, and in 1942 there were more than 7,000 such research workers in our industry.

It might be argued that other nations also have patent systems without getting such outstanding results but, as a matter of fact, the American patent system has very real advantages over most of the foreign systems in several respects. For example, it provides that the first inventor, and not the first one who files his application in the Patent Office, is entitled to the patent. This encourages a man to take adequate time to appraise his invention, work out the details, and even discuss it with others, without jeopardizing his position as the first inventor, providing he keeps adequate records.

For example, American patents are not subjected to heavy taxes or compulsory licensing provisions which greatly decrease their practical value, especially to an ordinary independent inventor during the early years when his financial resources are likely to be inadequate.

Furthermore, the fact that sound patents are generally respected by the responsible business interests of this country increases the market for, and the value of, a patent in contradistinction to the practices in many foreign countries. As John Anderson, an independent inventor of note, has well said:

"People seldom plant gardens where thieves abound and police protection is inadequate. Pirates are everywhere and inventors will not continue to invent, nor will small investors support their inventions, if patent rights are not sympathetically protected."

Another object of misinformed criticism is the simple cross-licensing agreement between parties actively engaged in similar lines of research. Such research generally results in many patent-office interferences and overlapping patents which would prevent any party from using the best process in sight. Under such circumstances there has been an increasing tendency to avoid the expense and delay attendant upon interference and infringement litigation by arbitrating the interferences and exchanging cross-licenses as to both past and future developments in a given field usually on a royalty-free basis. Such an agreement generally involves provisions for the licensing of others upon reasonable terms and a division of royalties based upon the best estimate of the parties as to the relative value of their respective positions. Usually each party also agrees to conduct further research in the field in question, and is left free to license his own patents on such terms as he sees fit.

In spite of recent attempts to arouse opposition to such arrangements labeling them all as "patent pools" without analyzing their provisions, it seems clear that the ordinary cross-licensing arrangement between companies actively engaged in research is very much in the public interest, since it facilitates and stimulates research, prevents unnecessary duplication, removes obstacles to prompt commercial development and avoids wasteful litigation. The free and prompt exchange of ideas and information between rival laboratories is a tremendous accelerator of new developments. Such arrangements also make available to an outside licensee all the necessary

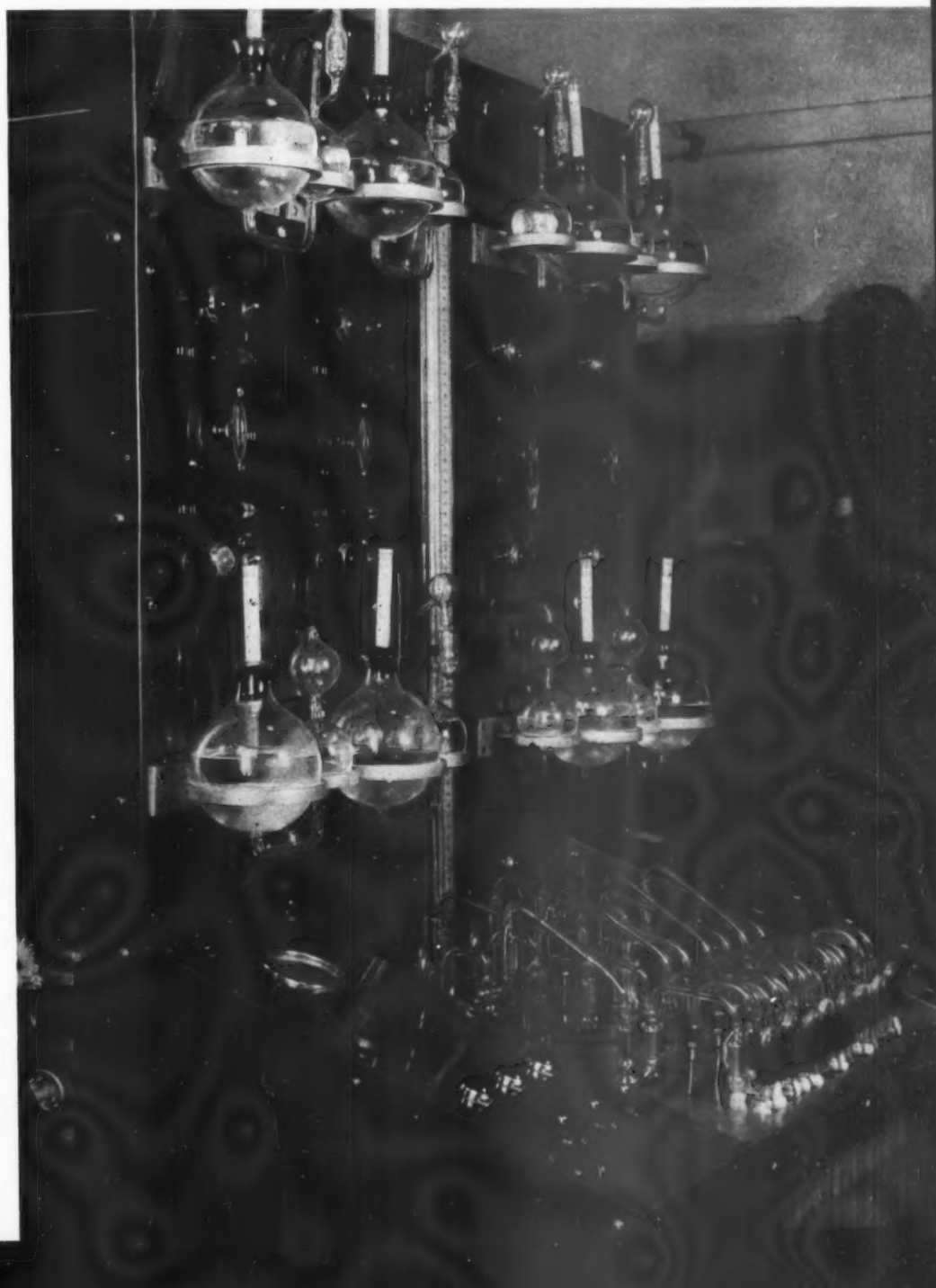
patents and, what is frequently more important, the combined experience of several companies so that he can select and operate the process best suited to his needs without having to acquire licenses and information from several different sources.

Emasculation of our patent system is bound to discourage much industrial research which has grown so amazingly in recent years until it employed about 70,000 research workers in 1940. However, the effect on the amount of research done will vary greatly with the industry, and particularly with the size of the company, and in a direction which would seem to be socially undesirable as it will in the long run weaken the competitive position of the smaller companies. Let us consider the relative effect on companies of the various sizes. A drastic weakening of our patent system will least affect the research policies of the large companies. Such companies can readily afford to carry on research programs covering all their competitive position and keeping down their manufacturing costs. They regard royalties mainly as incidental by-products of their research, and their main interest in patents is to help them secure maximum operating freedom by virtue of exchanges of licenses. Obviously, if they find it expedient not to depend on patents, such companies will not stop their research, but will tend to keep their know-how largely to themselves.

The effect of emasculation of our patent system on the research activities of medium size and smaller companies will be much more severe. Even such companies must, of course, keep some research organization if they are to keep anywhere near abreast of competition, but their laboratories cannot possibly do original research in all of their fields of activity. In general they concentrate mainly on their operating problems and studying the application of various patented processes to their own needs. In either type of work they frequently run across some new idea which seems to have merit, and even though their own activities would not justify the cost of a thorough investigation, as long as they have the prospect of patent protection and substantial royalty income, they can and do exploit such ideas, at least through the phase of laboratory development. Many small laboratories have more than financed all their research activities by one or two important inventions. Also, when they come to the point of needing to undertake large scale development, which in our industry frequently costs several hundred thousand or even a few million dollars, such companies can usually, by virtue of their patent protection, interest other companies in joining with them and sharing such development costs. Several small companies in our industry have attained a position of preeminence in certain fields by just such methods, but without the incentive and protection of a sound patent system the ideas would probably never have been developed. As Patent Commissioner Coe has said: "Speculative capital will not back new inventions without patent protection."

Another factor which would tend to reduce research in such companies would be that, without our patent and licensing system the companies which develop major new processes would not be giving out information and trying to sell licenses and hence the smaller companies would not be able to promptly study the application of these new processes to their own needs, so the whole process of development in industry would be retarded. Probably the most serious effect that emasculation of our patent system would have on the future of research would be to encourage the use of secret processes. This would be highly unfortunate, since one of the principal factors in the rapid advance of science and technology in the past 30 years has been the practical elimination of the secret process in favor of full disclosure and patenting as the preferable method of protecting one's rights and interests in his invention. If we take away a large part of the reward for disclosure, the tendency to revert to the dark ages of secret processes will be inescapable. The loss to our country would not be merely that due to the absence of competitive use of new processes, but even more in the slowing down of the exchange of basic information and new ideas. Inter-company research conferences and reports on new lines of development would practically cease and early publication of industrial research work would seldom be permitted. Industrial espionage would rear its ugly head, and efforts to prevent it would force the elimination of the "open door" policy of most of our industrial laboratories. As Kettering has said, "when you lock the research laboratory door you lock out a great deal more than you lock in," but serious weakening of our patent system would inevitably result in just such a situation. Modern industry based on applied science is a great cooperative affair which cannot thrive in a world ruled by secrecy.

Machine for testing relative resistance of lubricating oils to oxidation. Used by Shell in developing lubricating oils.



WOOD RIVER REFINERY RECEIVES ARMY-NAVY "E"

Above, left: Mrs. James H. Doolittle, and R. C. Roberts, Wood River Refinery Manager, holding Shell "E" pennant after presentation.

Above, right: Alexander Fraser, president of the Shell Oil Company, acknowledged the honor conferred by the award on the twenty-fifth anniversary of the refinery.

A DOUBLE CELEBRATION took place on January 15 at the Wood River (Ill.) refinery of Shell Oil Company. The immediate occasion was the award of the Army-Navy "E," the first to be conferred on an oil refinery for the high standard of its general contributions to the war effort. And Alexander Fraser, president of the company reminded his auditors that the current year marked the twenty-fifth anniversary of the refinery itself. Assigning credit for the honor conferred upon the plant to the entire body of workers Mr. Fraser said:

"This award is a tribute to the important role which you men and women have played in the war effort as well as to the technical research behind you which has made possible the production of vast quantities of vital war materials. It is this persistent, ceaseless search for new products from petroleum, as well as the constant improvement in the quality of existing products, which has contributed so much to the progress of our industry in recent years. And it would be remiss of me not to call attention to the fact that technical research, and the benefits which flow from it, constitute our best guarantee of continued employment after the war.

"The presentation exercises on this memorable day are an added spur to us to make still greater contributions and sacrifices for the boys who are fighting our battles and giving up their lives in distant lands to preserve the precious freedoms which our beloved country enjoys. So let us here and now dedicate ourselves to do everything in our individual power to help those boys in their heroic crusade, not forgetting our own Jimmy Doolittle, who has done so much at this very refinery to stimulate the production of aviation gasoline, and who is now carrying on so magnificently on the North African front. And may we pray that the day will soon dawn when the

flag of peace and victory shall proudly wave from a masthead towering high above this great refinery."

In presenting the award Col. Merle H. Davis, chief of the St. Louis ordnance district said: "In this war in which the integration and teamwork of all fighting arms and supply services into one enormous team is being stressed, it is difficult and sometimes almost impossible to separate the roles or assignments of the players. Nevertheless, we can divide the tools with which we fight the enemy into three great categories. They are: (1) ships, (2) Army and Navy aircraft, (3) Army and Navy ordnance.

"You have contributed to all three. Special marine lubricants developed here have been of important use in the Navy's operation of ships. The Shell Company was first to supply Army and Navy aircraft with 100 octane gasoline, and the toluene from this plant just goes across the river to the TNT plant operated by Army Ordnance to make TNT used by both the Army and the Navy. These three may be considered direct contributions from this refinery to the fighting forces.

"These items, of course, are superimposed on your industrial lubricating oils and fuels for both industrial plants and military and commercial vehicles. The whole integrated refinery is a part of the colossus that is now America's chemical industry. The importance to the war effort of the items which your plant produces needs no more elaboration than the recital of this list. Employees and management have made a huge joint contribution, and in comment upon your employees, I lay special stress on the devotion and hard work of your chemists and development engineers. Any chemical industry has to rest for its foundation upon its research organization.

"I understand that one of the items that struck the Army and Navy award board in consideration of whether or not a particular refinery of the Shell Oil Company should receive the Army-Navy "E" was the fact that it is a policy of the company, probably little known to the country at large, that when a Shell worker goes into the Army or Navy, his dependents receive 50 percent of his regular salary while he is in active service. This policy doubtless accounts in some measure for the relatively huge number of the employees of this company now in the armed services, for men could go with additional assurance of the safeguarding of their families. You may have heard of many awards of the Army and Navy "E". The award still has been made to only about one percent of the industrial plants in the country doing war work. You are joining, therefore, a real aristocracy of war production. I welcome you to the company of the elect. It signifies our trust that you will not let us down."

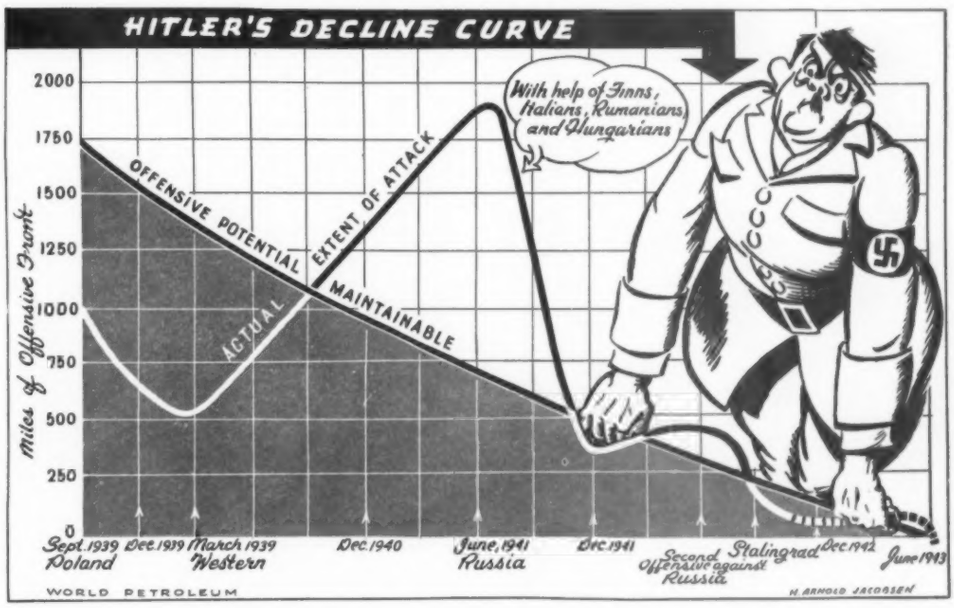
Among the gold braided uniforms and the prominent business men and officials who attended the ceremonies the guest who was greeted with most enthusiasm was Mrs. Jimmy Doolittle, wife of the famous flyer, now Major General in command of air forces in North Africa. In a gracious little speech Mrs. Doolittle referred to the ten happy years that she and her husband had spent as members of the Shell family. A message from General Doolittle himself addressed to the men and women of the Wood River plant read: "As a former fellow worker I congratulate you upon winning the Army-Navy production award. It is the Distinguished Service Cross of the production soldier." Messages of congratulation also were received from Petroleum Administrator Ickes and Robert P. Patterson, Under Secretary of War.

Accompanying President Fraser to Wood River was a party of company officials from New York, including F. A. C. Guepin, executive vice president; J. W. Watson, treasurer; J. F. M. Taylor, vice president in charge of manufacturing; R. B. Roark, vice president in charge of the mid-continent production area; N. J. McGaw, vice president for transportation and supplies and C. E. Davis, manager of the manufacturing department. Other Shell officials present were P. H. Swinchatt, vice president of the Shell Pipeline Corporation; B. H. Symon, manager of lubricating sales; E. G. Robinson, manager of the eastern production area; G. G. Biggar, manager of public relations; L. A. Lohman, industrial relations representative; R. B. High, manager of the Washington office; H. Swanson, division manager at Chicago; J. G. Sinclair, division manager at Indianapolis; Horace Dale, assistant manager of the Wood River Refinery; H. F. Brown, sales promotion advertising representative; and J. Ebel, editor of Shell News.

GEOLOGIST PLOTS HITLER'S DECLINE CURVE

GEOLOGIST H. H. SUTER of Pointe a Pierre, Trinidad, has applied a method familiar to members of the oil industry to charting the course of Nazi war power. This decline curve as envisioned by Mr. Suter is presented herewith. It is based on the elements of time and space as they affect Hitler's ability to maintain the broad scope of operations on which his hope of conquest is based.

In forwarding his unique chart to WORLD PETROLEUM Mr. Suter writes: "For oil people accustomed to reading decline curves the enclosed graph is self-explanatory. As you will note the curve is not strictly asymptote, this deliberately so because Hitler is licked as soon as he can no longer attack on a "geopolitical scale", to use a term now fairly familiar. The curve was drawn before the invasion of North Africa but developments there simply confirm the trend shown by the other events listed. I feel that this compilation may be of interest to some of your readers and that members of the oil industry will be better able than others to gauge the probability of the graph".



Apparently the conclusion which the author seeks to convey is that by drawing too heavily upon his available resources in undertaking the Russian adventure in 1941 Hitler exposed himself to the rapid decline in his offensive power which is now being realized. To avoid possible embarrassment to the constructor of the graph it may be added that the pictorial embellishment which has been incorporated with it is the work of WORLD PETROLEUM artist H. Arnold Jacobsen.

Foreign Oil Legion

Left: J. F. M. Taylor
and above H. Bloemgarten

APPOINTMENT of two new vice presidents of Shell Oil Company was announced by President Alexander Fraser on January 1. J. F. M. Taylor, who has served for the past several years as president of Shell Development Company with headquarters in San Francisco succeeds to the position of vice president in charge of refining vacated by E. D. Cumming who was recently appointed Director of the Division of Refining of the Office of Petroleum Administrator for War. H. Bloemgarten, who has had a broad experience on the production side of the oil business extending to many parts of the world, becomes vice president in charge of exploration and production.

Dr. Per K. Frolich

DR. PER K. FROLICH, director of the Chemical Division of Esso Laboratories, Standard Oil Development Company, a leading figure in research leading to the present position of the oil industry as a source of materials for the production of synthetic rubber, began his term as president of the American Chemical Society on January 1.

Thomas Midgley, Jr.

Dr. Thomas Midgley, vice president of The Ethyl Corporation, who has won fame for many additions to technical knowledge including the discovery of tetraethyl lead as an anti-knock additive to gasoline, becomes president elect and will automatically succeed to the presidency of the Society in 1944.

IN A MOVE that provides direct company representation on the Atlantic Seaboard, The Fluor Corporation, Ltd. announces the opening of a direct company branch office in New York City at 1919 R.C.A. Building, with J. I. Lawrence, formerly of the company's Kansas City office, in charge.

RALPH W. GALLAGHER, chairman of the board of Standard Oil Company (N.J.) has been elected president of the company to succeed W. S. Farish whose death occurred in November last. Eugene Holman, vice president of the company, has become a member of the executive committee of the board.

F. A. WATTS, purchasing agent of Humble Oil & Refining Co., Houston, has been appointed director of the Materials Section, Division of Production, Office of Petroleum Coordinator for War. Mr. Watts succeeds Greer W. Orton who accepted the post last July on the understanding that his service was to be temporary.

A. Clarke Bedford

A. CLARKE BEDFORD became general sales manager of the Standard Oil Company of New Jersey and its affiliated Esso Marketers on January 1, succeeding R. T. Haslam recently elected director of the parent company Standard Oil Company (N.J.) Mr. Bedford has been connected with the Standard group for nearly thirty years serving in various branches of its operations continuously except for a period in World War I when he was a Captain in the U. S. Army in France. Since 1936 he has been assistant sales manager of Standard Oil Company of New Jersey.

C. W. (BILL) ECKMAN, well known figure among refiners and independent distributors of petroleum products in Pennsylvania and the Southwest has been appointed assistant general manager of the Northwestern Refining Company at St. Paul.

OFFICERS for the year 1943 were elected at the Annual Meeting of the Los Angeles Chapter of Nomads held in Los Angeles, Wednesday evening, January 13, 1943. Ballots were opened at a business session preceding the regular dinner by past presidents of the Chapter, Elmer Decker and Ted Sutter. The result of the voting was: Henry Pullman, president; Roland Smith, vice president; Wallace A. Sawdon, secretary; Tom Martin, assistant secretary; Elmer Smith, treasurer; Roger Henquet, assistant treasurer; J. V. Robinson, sergeant at arms, and George Trembley, deputy sergeant at arms. The National Regents elected to represent the Chapter on the Board of Regents of the Nomads were W. (Bill) F. Bettis and W. R. (Frosty) Martin. Plans for the Fourth Annual Inaugural Ball to be held in February were then discussed and H. E. Cassidy, Lew Bronzan and Wallace Sawdon were appointed by President Bettis to aid the Entertainment Committee consisting of Roland Smith, chairman, and J. V. Robinson in making final arrangements for this affair.

DR. BLAINE B. WESCOTT, chief of the materials and products chemistry division of the Gulf Research and Development Company, Pittsburgh, Pa., has been appointed a member of the Sectional Committee on Pipe Threads of the American Standards Association. The scope of the Committee covers the American (Briggs) Standard taper and straight pipe threads, plumbers' threads, threads for electrical conduit and threads for thin tubes.

MARTIN NEILSEN, for the past several years refinery superintendent for Gas and Oil Products Limited in Turner Valley, Canada, has been appointed plant superintendent for Abasand Oils Limited, with headquarters at Fort McMurray, Alberta. Mr. Neilsen will be in immediate charge of Abasand's production of petroleum products from the Athabaska oil sands.

P. J. (PAT) RYAN, manager of sales operations for Continental Oil Company, has been called to Washington to serve in the reclamation section of the Marketing Division of the Office of Petroleum Administrator for War. A native of Ireland Mr. Ryan came to New York as a youth and after several years with a brokerage firm went to Mexico and entered the oil business becoming vice president of the Marland Oil Company in 1928. He remained with the Continental when it succeeded Marland and has been in charge of sales operations since 1935.

P. J. Ryan

Admiral H. L. Vickery, Carl Flesher, Pacific Coast regional director of the Maritime commission, Charles E. Moore, president, and Felix Kahn, treasurer of Joshua Hendy Iron Works inspect new plant facilities at the big Sunnyvale plant which flies both the Maritime Commission's "M" flag and the Army-Navy "E" flag.

HENDY ACQUIRES POMONA PUMP

RECENT ACQUISITION of a number of long established and widely known manufacturing concerns has made the name of the Joshua Hendy Iron Works familiar to all parts of the country in connection with the swiftly growing program of war production. Less familiar but of equal significance is the name of Charles E. Moore, the mainspring of the organization which was established back in 1856 at Sunnyvale, California, to build gold mining machinery but has now become one of the important factors in the tremendous expansion of the country's merchant fleet.

Initially assigned the task by the Maritime Commission of building 2500 h.p. triple expansion steam engines for our new EC-2 freighters, Charley Moore adopted the idea of producing these 271,000 pound monsters by mass production methods. Now, the Joshua Hendy plant, expanded to cover more than sixty acres, is averaging between eight and ten of these engines a week and production is going up.

In achieving engine production to keep pace with ship launchings on the west coast, there developed a number of bottlenecks in other types of necessary ship fittings and equipment, particularly in the line of steam turbines, pumps, motors and electrical control. To help meet this situation Mr. Moore purchased the fifty-five year old Crocker-Wheeler Electric Manufacturing Company of Ampere, New Jersey. This concern, one of the oldest and best known names in the electrical industry, already engaged in the production of motors and control equipment for the war effort, is to be greatly expanded under the management of A. J. M. Baker, a former co-worker of Mr. Moore's when both of them were assisting in the Lend-Lease program. Through acquirement of Crocker-Wheeler Electric Manufacturing Company, Hendy extended its line from steam engines and steam turbines to turbo-generators, motors and other electrical equipment.

This still did not meet the urge in the mind of Charley Moore to break existing bottlenecks in shipbuilding, so he gathered into the fold the Pomona Pump Co. of Pomona, California and St. Louis, Missouri, along with its subsidiary, Westco Pump Division. Pomona, over a period of forty years, and Westco, during the past twenty-five years, have built up a record of successful application of their pumps in hundreds of industrial usages, as well as in agriculture, municipalities and marine service. Both were possessed of huge backlogs of orders for pumps for war service, but Charley Moore needed, and therefore procured, the Pomona organization and its "know how" in the design, manufacture and application of a wide range of types and kinds of pumps.

George A. McKenna, President, chief owner and guiding genius of the Pomona Pump Co. since 1924, together with the entire executive personnel, has been retained intact by Moore. In addition to the plants in Pomona and St. Louis, an entirely new twenty-five acre plant located at Torrance, California, and perfectly equipped for the manufacture of pumps has been purchased and turned over to Pomona Pump Co., Division of the Joshua Hendy Iron Works.

WORLD PETROLEUM ABSTRACTS

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing with Technical and Economic Aspects of the Petroleum Industry — Edited by Dr O. W. Willcox.

GEOLOGY

Reservoir Analysis and Geologic Structure—J. M. Bugbee, in PETROLEUM TECHNOLOGY, Technical Publication No. 1527, November, 1942; 12 pages.

The engineer and the conservationist agree that effective water drive is the desirable reservoir production mechanism. Water drive may result either from the expansion of edge water, the reservoir water bordering an oil pool, or from the artesian flow of edge water from the outcrop. Thus, the extent of the reservoir has an important bearing upon both the rate and the ultimate quantity of water influx to an oil pool.

Lens-type reservoirs are generally recognizable, but the complete structure of the more important domal types, having possible limitations from crestal and synclinal faulting, is not well understood. The delineation from cores, electrical logs and exploitation phenomena of the crestal portions of reservoirs is increasingly exact. This paper suggests that inference from these factual pictures, combined with the scattered well and geophysical data of the synclines and with consideration of the dynamics of structural formation, may be applied to solving the complete geologic structure. Since faulting on the domes and in the synclines may effectively seal and thus limit the size of a reservoir and bar additional water influx, consideration of geologic structure and its possible effects is essential to complete analysis and prediction of reservoir performance.

DRILLING

Calibration and Control of the Supercentrifuge for the Fractionation of Oil-Well Drilling Muds—S. C. Oliphant, C. R. Houssiere, Jr., and George H. Faucher, in PETROLEUM TECHNOLOGY, Technical Publication No. 1530, November, 1942; 7 pages.

Drilling mud can be an item of great expense on the Gulf Coast. In order to understand the nature of a drilling mud, it is desirable to know the composition and size of the mineral particles that are present. The supercentrifuge has been adapted to the fractionation of mud, and this paper discusses the calibration and methods of operation and control.

OPERATION

Productivity of Oil Wells and Inherent Influence of Gas: Oil Rabos and Water Saturation—R. V. Higgins, in BUREAU OF MINES REPORT OF INVESTIGATIONS NO. 3657, September, 1942; 50 pages.

This report presents the results of a study of the influence of gas:oil ratios and water saturation on the decline in productivity indexes of oil wells; the changes occurring in gas:oil ratios and water saturation in the sand surrounding the well over long periods are discussed and their influence analyzed; and it is shown that the application of field data and their correlation with the evaluation of well performance will assist petroleum engineers to secure maximum recovery of oil from underground reservoirs.

The report contains a graph showing a correlation between gas:oil ratios, water saturation, and relative permeability of oil-producing sands, which will prove helpful to petroleum engineers analyzing the producing performances of wells. Equations also are given by means of which the initial productivity index of a well can be estimated when the average water saturation in the sands about a well and their permeability are known, and these equations can be used to determine the efficiency of well-completion methods.

As many essential well-performance data often are lacking, and it is impossible to analyze completely the producing behavior of wells by means heretofore used, the writer has developed a ratio method (discussed in the report) that gives satisfactory results with a minimum of field data. The ratio method makes it possible to use productivity indexes to determine whether (1) water entering a well is coming from a part of the formation that might be plugged off without decreasing the oil-producing capacity of the well; (2) gas flowing from a high-gas:oil-ratio well is largely from the gas cap or a gas sand that might be cemented off; and (3) after a well has produced oil for a year or more, the face of the producing sand exposed to the well has become clogged by water, silt, salts, or semisolid hydrocarbons.

A number of numerical examples are given in the report, which show that (1) extensive changes in the distance of the pressure source from wells have minor influence on productivity indexes; (2) the diameter of wells has a material influence on their ability to yield oil; and (3) the evaporation of some of the interstitial water as a result of differences between the partial pressures in the immediate vicinity of wells and back in the formation may increase their productivity.

A discussion of one-, two-, and three-phase flow through reservoir sands also is included because of its bearing on productivity indexes.

Analysis of Reservoir Performance—R. E. Old, Jr., in PETROLEUM TECHNOLOGY, Technical Publication No. 1529, November, 1942; 7 pages.

Quantitative methods are presented that are applicable for identification and determination of magnitude of water encroachment, determination of initial oil in place, and calculation of pressure behavior in oil reservoirs. The methods are illustrated in a study of the Schuler field, Jones sand

No. 3 OF A SERIES
TO HELP YOU KEEP
CRACKING STILLS
OPERATING AT
PEAK EFFICIENCY
CARE IN USING
TUBE ROLLING
EQUIPMENT
Before rolling a tube into a header or tube sheet, the tube ends and header section should be thoroughly cleaned. No grease or oil should remain on the surface or in the serrations. These elements resist compression and will not permit the proper flow of metal. If this is neglected, heat will ultimately create hard carbon preventing re-rolling and often causing accidents.
The entire rolling tool should also be cleaned frequently in some form of distillate to remove mill scale and other foreign matter. This prevents flaking of the rolls, mandrel and the rolled section of the tube.
AIRETOOL MANUFACTURING CO.
Dept. WP, SPRINGFIELD, OHIO
Manufacturers of Tube Cleaners, Tube Expanders and other Refinery specialties.

The Sign of Fine Petroleum Products

Mobilgas ★ Mobiloil

Mobilubrication ★ Mobil Specialties

SOCONY-VACUUM OIL COMPANY, INC.

26 BROADWAY · NEW YORK CITY

Water encroachment was determined in two different manners. With two years of pressure-production records as a background, pressure behavior for the following three years was calculated and compared with actual measurements. The satisfactory agreement obtained between the calculated and measured values authenticates the method used.

It is apparent from this and similar studies that the use of the material-balance and water-drive equations when properly applied to field data gives a fundamental tool for evaluation of reservoir performance. One especially important usage is in the determination of pressure behavior. Critical rates of production may be established for water-drive fields. Rates and quantities of injected water to supplement natural encroachment may be predetermined. The effect of gas injection can be known before such program is initiated. Thus the effects of various production programs can be safely evaluated beforehand. When these determinations are combined with core-analysis saturation data, the economics of recovery under each can be analyzed, and the most profitable one selected.

These calculations can be made when reservoir-pressure measurements, production records of oil, water and gas, and bottom-hole sample analyses are known. Determination of structural dimensions using porosity, connate water and permeable thickness from core analyses will aid in earlier application and increased accuracy of results.

The Effect of Casing Perforations on Well Productivity—Morris Muskat, in PETROLEUM TECHNOLOGY, Technical Publication No. 1528, November, 1942; 10 pages.

Analytical calculations have been carried out on the effect of casing perforations on the productivity of wells, and formulas have been derived for general types of perforation patterns. The numerical calculations, however, show that the resultant well productivity is essentially independent of the perforation pattern, but is determined mainly by the total perforation density. Thus, for example, for a density of three perforations per foot of casing, the well productivity will be cut to one third of that of the uncased well for a perforation radius of ⅛ in., and to approximately one half for a perforation radius of ¼ in., regardless of the detailed manner in which the perforations are distributed over the casing surface. The analytical theory is also extended to include wells completed with slotted liners. It is shown that the reduction in productivity due to such liners will be relatively small as compared with that due to perforated casings.

Tracer Gas Used to Check Repressuring Progress—Harry F. Simons, in OIL & GAS JOURNAL, Vol. 41, (1942), No. 28, page 36.

A good method for tracing the path of the gas used for repressuring projects is highly desirable, particularly a method for measuring the time required for the gas to pass from the injection to the producing well. Determination of the gas:oil ratio in the producing well is not satisfactory.

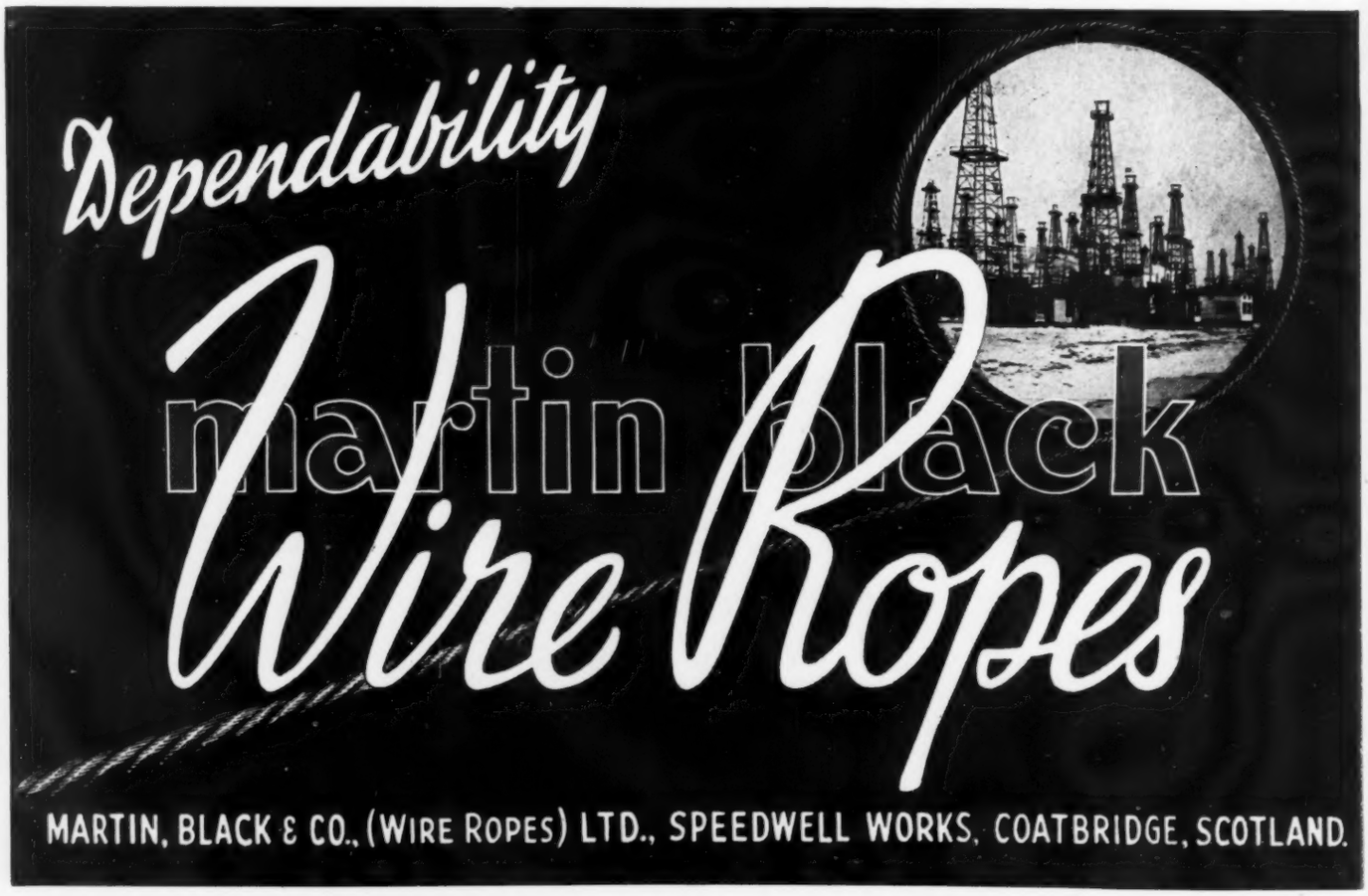
In Carter Oil Company's repressuring project in the Louden (Ill.) field, the pressure gas is mixed with a tracer gas (produced from carbon dioxide and charcoal in a special small plant). This gas is bottled under 900 lbs. pressure and a certain number of bottles are connected to a bypass at the injection wells. Tests are made at intervals to note the first appearance of the tracer gas at the producer wells.

These tests show whether or not the drive on the oil is proceeding as planned or is developing unevenly. The operator may then decide on what corrective measures it may be possible to apply.

NATURAL GAS

Importance of Natural Gasoline and Its Derivatives to the Synthetic Rubber and Aviation Gasoline Programs—Paul M. Raigorodsky and Frank H. Dotterweich before WESTERN PETROLEUM REFINERS' ASSOCIATION, Wichita Meeting, November, 1942.

To meet the necessities of the synthetic rubber program there are five major processes under development or consideration for producing butadiene by thermal cracking: (1) low pressure, high temperature thermal cracking by the flue gas heating system; (2) low pressure, high temperature thermal cracking by the steam regenerative system; (3) thermal cracking, using direct air injection; (4) thermal cracking, with regenerative furnaces; (5) tubular cracking. Most of these processes depend on quickly raising the temperature of the charge to obtain optimum cracking conditions, and then interrupting the reaction quickly to prevent decomposition of the desired products, which are separated by accurate fractionation. The regenerative principle (Wulff furnace) is also used for the production, of acetylene and ethylene, themselves im-



portant sources of synthetic rubber products. The raw charge may be any hydro-carbon heavier than methane, such as are found in natural gasoline. Whether acetylene, ethylene, or butadiene is to be produced depends on temperature-time conditions. A recirculatory cracking process considerably increases the yield of acetylene at the expense of ethylene.

Acetylene is an important source for the manufacture of butadiene, which is the base for Buna S and Buna N rubbers and neoprene. Ethylene is the base for thiokol rubber substitute and neohexane for aviation fuel, besides many other useful products.

Besides the five thermal cracking processes for the production of butadiene, there are two catalytic processes. One of these is the Universal Oil Products process, and the other is the Houdry combined, two-stage dehydrogenation catalytic process. Both these processes make butadiene by dehydrogenating normal butane. It is said that these catalytic processes require a minimum of critical materials, mainly limited to special reacting vessels. In the Houdry process butylene may be produced instead of butadiene by a simple change in operating conditions. It is likely that a single stage process instead of the present two-stage process may develop from research now under way.

A recent survey has shown that enough normal butane is available (if collected) to meet prospective demands for this important hydrocarbon.

The Schoch electrical process for making acetylene and carbon black is attracting some attention; it is said to produce acetylene more cheaply than is being done by the carbide process. New and highly important processes for making carbon black by controlled combustion are summarized.

Fractionation of natural gasoline is now being carried to the point of producing a 70 A P c naphtha with 300° e.p. that meets aviation gasoline requirements. Other major developments in the production of aviation gasoline are reviewed in this paper.

Viscosity Characteristics of Lubricating Oils Saturated with Natural Gas at High Pressures—Judson S. Swearingen and Edwin D. Redding, in INDUSTRIAL ENGINEERING CHEMISTRY, Vol. 34 (1942), No. 12, pp. 1496-1498.

Compressors are important adjuncts in the transportation of natural gas through pipe lines, in the operation of high-pressure gas cycling, and in numerous process applications. These compressors have to be lubricated, and the case presents itself of oil in the presence of gas under high pressure; the question is raised as to what effect this will have on the lubricating character of the oil.

The authors studied this question by the use of a specially constructed viscosimeter. They found that one effect of the high pressure was to cause some of the gas to be dissolved in the oil, and the viscosity of the oil and hence its lubricating character is altered. The viscosity of a heavy lubricating oil is reduced more than that of a light oil. This suggests that the method will be of assistance in choosing and compounding lubricating oils for gas compressor service.

NATURAL GAS

Degasification of Coal Seams—Leo Ranney, in MINING AND METALLURGY, Vol. 24 (1943), No. 433, pp. 13-15.

The author points out that there is an enormous reserve of natural gas in the form of fire damp (mostly methane) in the bituminous coal fields of the eastern part of the United States. In one West Virginia coalfield there is a seam of coal which contains upwards of two trillion cubic feet of absorbed methane, figured at 20 million cubic feet per acre. This gas is held in the coal itself under the pressure of the rocks and is gradually released when the seam is opened, and frequently gives rise to disastrous mine explosions. Many wells have been drilled into the Pittsburgh coal seam in southwestern Pennsylvania for the sole purpose of obtaining natural gas. One such well drilled into an 8-foot seam yielded 48,860,000 cu. ft. of gas in the first seven months. Similar wells have been exploited in Ohio.

The author suggests that the vast extent of this coal gas reserve warrants exploitation both as an addition to present sources of this fuel, and as a contribution toward making coal mining safer. He estimates that approximately 500,000,000 cubic feet of natural gas is being wasted every day at the country's bituminous coal mines. In 1940 some 275 miners were killed by mine gas explosions. A practicable method would be to sink a shaft to the coal seam and from the bottom of this shaft drill horizontal radial holes into the seam for distances up to 5,000 feet. The practicability of such horizontal drilling has already been demonstrated on the First Cow Run Sand in Ohio. When the well has been properly completed a vacuum pump at the surface would be used to apply suction to the hole

in the coal seam, and the gas delivered to a pipe line; no air will be sucked in.

It is estimated that the overall cost of producing gas from these horizontal wells in gassy seams will be about 5 cents or less per 1,000 cu. ft. At current prices the production of 50 million cu. ft. would liquidate the cost, and from then on the cost of production would be about 2½ cents. There are vast areas of coal lands that will not be mined for 25, 50 or 100 years. If this coal is degasified, the subsequent mining operations will be freed from the existing explosion hazards and the cost of ventilation.

It is pointed out that the matter has considerable importance for the Appalachian region and the Eastern seaboard. This region is highly industrialized and at the same time has no great amount of natural gas reserves and is becoming increasingly dependent on supplies piped from the distant Southwest. The author concludes by giving his opinion that a greater daily gas supply of gas can be obtained from the eastern coal fields by this method than would be delivered by a 24-inch pipeline from the Southwest, at a fraction of the construction cost and a fourth of the operating cost of such a line.

CHEMISTRY

Analysis of Ethylene in Presence of Butane—James J. Eberl, in INDUSTRIAL ENGINEERING CHEMISTRY, Analytical Edition, Vol. 14 (1942), No. 11, p. 853.

The disadvantages of the fuming sulfuric acid and the bromine method for the analysis of ethylene have been discussed by Gooderham, who suggests the use of concentrated sulfuric acid containing 1 percent silver sulfate as a catalyst for the analysis of ethylene in fuel gas.

It was found that the reagent described by Gooderham gave rapid absorption of ethylene but was not entirely specific in the presence of butane. About 0.5 cc. of butane was absorbed per passage of 100 cc. of pure butane gas at atmospheric pressure.

In order to eliminate the error due to butane absorption a new reagent was developed. This reagent is prepared by adding 12 grams of silver sulfate to 200 cc. of 72 percent sulfuric acid. The reagent absorbs ethylene rapidly and gives no error due to butane absorption. A 2-minute time of passage was used throughout the analysis.

Determination of Inhibitors in Petroleum Products—C. E. Nabuco de Araujo, Jr., and Leopold A. Miguez de Mello, in ANAIS ASSOCIACAO QUIMICA BRASIL, Vol. 1 (1942), No. 1, pp. 16-18.

Inhibitors in petroleum products have the function of preventing the formation of oxidation products of a gummy or acid nature. All inhibitors in petroleum products found on the Brazilian market react with potassium hydroxide, and the authors use this fact to measure the amount of inhibitor present, provided that the saponification number of the inhibitor is known. If that is the case, by determining the saponification number and the acid number of the oil or gasoline, the amount of inhibitor used can be calculated. If the saponification number of the inhibitor is not known a rough and ready test is to simply determine the saponification number of the inhibited in comparison with uninhibited samples. Thus uninhibited aviation gasoline may require 0.25 milligram of KOH per gram of sample, while an inhibited sample will require 1.75 milligrams.

PHYSICS

Surface Energy Relationships in Petroleum Reservoirs—H. K. Livingston, in PETROLEUM TECHNOLOGY, Technical Publication No. 1526, November, 1942; 6 pages.

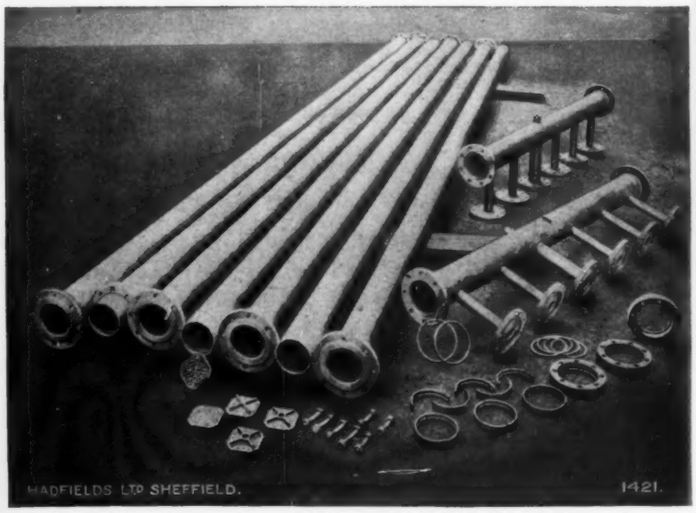
A technique has been developed which makes it possible to determine the spreading pressure of liquids and solids, for simple systems. Data for surface tensions, interfacial tensions, spreading pressures, and contact angles for water, heptane and silica are tabulated. These results can be applied to the evaluation of capillary rise and displacement pressure in a petroleum reservoir. Appropriate equations are presented and the application of these equations is discussed. The presence of surface-active components affects both capillary rise and displacement pressure and also seems to influence the rate of fluid flow.

REFINING

Reducing Ash Content of Residual Oils with Boric Acid—E. T. Scafe, K. F. Hayden and V. A. Kalichevsky, in INDUSTRIAL ENGINEERING CHEMISTRY, Vol. 14, (1942), No. 12, pp. 923-926.

Petroleum crude oils containing appreciable quan-

HIGH QUALITY
STEELS
FOR THE OIL INDUSTRY.
TRADE ERA MARK
H.R.
HEAT-RESISTING STEELS
HAVE NUMEROUS APPLICATIONS.
For parts of plant requiring rigidity and low scaling loss at high temperatures they are unequalled.
TRADE ERA MARK
C.R.
NON-CORRODING STEELS
FOR THERMOWELLS, REACTION VESSELS, PUMP PARTS, BUBBLE CAPS.
Highly resistant to the attack of numerous chemical agents.



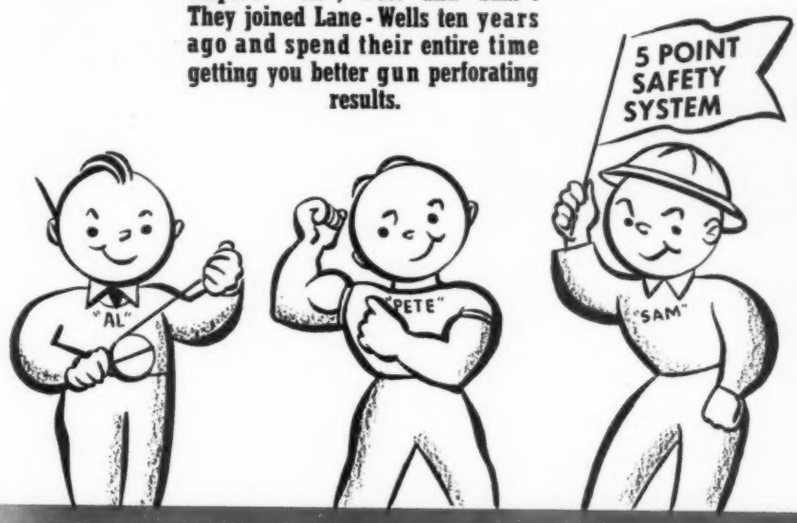
REFORMER OVEN TUBES AND FITTINGS OF HADFIELDS "ERA H.R." HEAT-RESISTING STEEL. FABRICATED FROM ROLLED PLATES AND WELDED TOGETHER. LENGTH OF TUBES 24 FEET 1¾ INCHES, INSIDE DIAMETER 6 INCHES.

HADFIELDS LTD.
EAST HECLA WORKS • SHEFFIELD • ENGLAND.
No. 2517

MEET the 3 HELPERS

OF EVERY LANE-WELLS FIELD CREW

On the job with every Lane-Wells field crew are three important helpers—"Al", "Pete" and "Sam". They joined Lane-Wells ten years ago and spend their entire time getting you better gun perforating results.



"AL" ACCURACY

"Al" works on measurement to make sure that shooting depths check accurately . . . "Al" pioneered the method of line calibration and the use of test wells to check, recheck and season each line for the most effective results.

"PETE" PENETRATION

"Pete" came up the hard way and knows how to pack the hardest punch in the shortest distance—directly back of each bullet—to perforate multiple strings of casing and penetrate far out into formation.

"SAM" SAFETY

"Sam's" job is of vital importance . . . to protect your men and your investment. A five-point safety system . . . guards against premature firing and other hazards. "Sam" makes sure every precaution is taken to insure a safe, successful job.

You can meet these boys in person on your next Gun Perforating job. Climb up into the cab of the Lane-Wells field truck and ask the operator to show you just how they work and why they help get you results.

FIGHTING
Tomorrow's Tools-Today!

LANE WELLS COMPANY

General Offices and Export Offices
5610 South Soto Street • Los Angeles

24-HOUR SERVICE—30 BRANCHES

in the coal seam, and the gas delivered to a pipe line; no air will be sucked in.

It is estimated that the overall cost of producing gas from these horizontal wells in gassy seams will be about 5 cents or less per 1,000 cu. ft. At current prices the production of 50 million cu. ft. would liquidate the cost, and from then on the cost of production would be about 2½ cents. There are vast areas of coal lands that will not be mined for 25, 50 or 100 years. If this coal is degasified, the subsequent mining operations will be freed from the existing explosion hazards and the cost of ventilation.

It is pointed out that the matter has considerable importance for the Appalachian region and the Eastern seaboard. This region is highly industrialized and at the same time has no great amount of natural gas reserves and is becoming increasingly dependent on supplies piped from the distant Southwest. The author concludes by giving his opinion that a greater daily gas supply of gas can be obtained from the eastern coal fields by this method than would be delivered by a 24-inch pipeline from the Southwest, at a fraction of the construction cost and a fourth of the operating cost of such a line.

CHEMISTRY

Analysis of Ethylene in Presence of Butane—James J. Eberl, in INDUSTRIAL ENGINEERING CHEMISTRY, Analytical Edition, Vol. 14 (1942), No. 11, p. 853.

The disadvantages of the fuming sulfuric acid and the bromine method for the analysis of ethylene have been discussed by Gooderham, who suggests the use of concentrated sulfuric acid containing 1 percent silver sulfate as a catalyst for the analysis of ethylene in fuel gas.

It was found that the reagent described by Gooderham gave rapid absorption of ethylene but was not entirely specific in the presence of butane. About 0.5 cc. of butane was absorbed per passage of 100 cc. of pure butane gas at atmospheric pressure.

In order to eliminate the error due to butane absorption a new reagent was developed. This reagent is prepared by adding 12 grams of silver sulfate to 200 cc. of 72 percent sulfuric acid. The reagent absorbs ethylene rapidly and gives no error due to butane absorption. A 2-minute time of passage was used throughout the analysis.

Determination of Inhibitors in Petroleum Products—C. E. Nabuco de Araujo, Jr., and Leopold A. Miguez de Mello, in ANAIS ASSOCIACAO QUIMICA BRASIL, Vol. 1 (1942), No. 1, pp. 16-18.

Inhibitors in petroleum products have the function of preventing the formation of oxidation products of a gummy or acid nature. All inhibitors in petroleum products found on the Brazilian market react with potassium hydroxide, and the authors use this fact to measure the amount of inhibitor present, provided that the saponification number of the inhibitor is known. If that is the case, by determining the saponification number and the acid number of the oil or gasoline, the amount of inhibitor used can be calculated. If the saponification number of the inhibitor is not known a rough and ready test is to simply determine the saponification number of the inhibited in comparison with uninhibited samples. Thus uninhibited aviation gasoline may require 0.25 milligram of KOH per gram of sample, while an inhibited sample will require 1.75 milligrams.

PHYSICS

Surface Energy Relationships in Petroleum Reservoirs—H. K. Livingston, in PETROLEUM TECHNOLOGY, Technical Publication No. 1526, November, 1942; 6 pages.

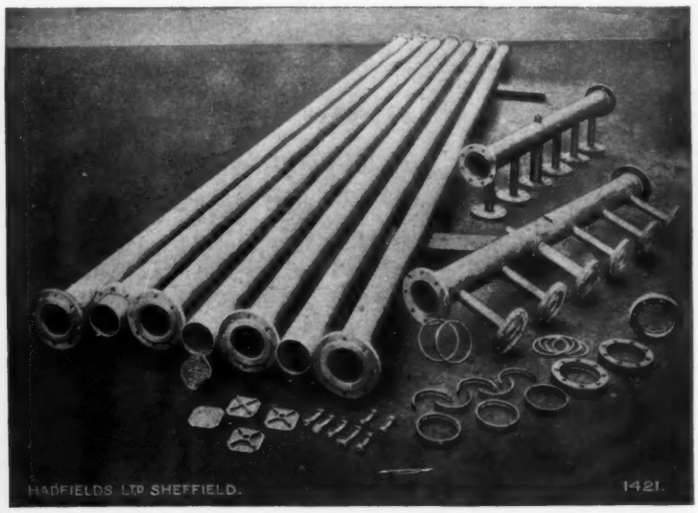
A technique has been developed which makes it possible to determine the spreading pressure of liquids and solids, for simple systems. Data for surface tensions, interfacial tensions, spreading pressures, and contact angles for water, heptane, and silica are tabulated. These results can be applied to the evaluation of capillary rise and displacement pressure in a petroleum reservoir. Appropriate equations are presented and the application of these equations is discussed. The presence of surface-active components affects both capillary rise and displacement pressure and also seems to influence the rate of fluid flow.

REFINING

Reducing Ash Content of Residual Oils with Boric Acid—E. T. Scafe, K. F. Hayden and V. A. Kalichevsky, in INDUSTRIAL ENGINEERING CHEMISTRY, Vol. 14, (1942), No. 12, pp. 923-926.

Petroleum crude oils containing appreciable quan-

HIGH QUALITY
STEELS
FOR THE OIL INDUSTRY.
TRADE ERA MARK
H.R.
HEAT-RESISTING STEELS
HAVE NUMEROUS APPLICATIONS.
For parts of plant requiring rigidity and low scaling loss at high temperatures they are unequalled.
TRADE ERA MARK
C.R.
NON-CORRODING STEELS
FOR THERMOWELLS, REACTION VESSELS, PUMP PARTS, BUBBLE CAPS.
Highly resistant to the attack of numerous chemical agents.



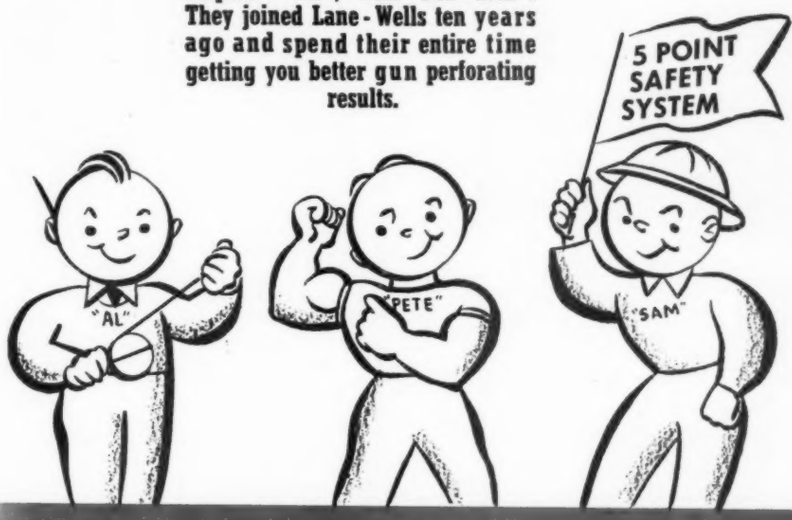
REFORMER OVEN TUBES AND FITTINGS OF HADFIELDS "ERA H.R." HEAT-RESISTING STEEL. FABRICATED FROM ROLLED PLATES AND WELDED TOGETHER. LENGTH OF TUBES 24 FEET 1¾ INCHES, INSIDE DIAMETER 6 INCHES.

HADFIELDS LTD.
EAST HECLA WORKS • SHEFFIELD • ENGLAND.
No. 2517

MEET the 3 HELPERS

OF EVERY LANE-WELLS FIELD CREW

On the job with every Lane-Wells field crew are three important helpers—"Al", "Pete" and "Sam". They joined Lane-Wells ten years ago and spend their entire time getting you better gun perforating results.



"AL" ACCURACY

"Al" works on measurement to make sure that shooting depths check accurately . . . "Al" pioneered the method of line calibration and the use of test wells to check, recheck and season each line for the most effective results.

"PETE" PENETRATION

"Pete" came up the hard way and knows how to pack the hardest punch in the shortest distance—directly back of each bullet—to perforate multiple strings of casing and penetrate far out into formation.

"SAM" SAFETY

"Sam's" job is of vital importance . . . to protect your men and your investment. A five-point safety system . . . guards against premature firing and other hazards. "Sam" makes sure every precaution is taken to insure a safe, successful job.

You can meet these boys in person on your next Gun Perforating job. Climb up into the cab of the Lane-Wells field truck and ask the operator to show you just how they work and why they help get you results.

FIGHTING
Tomorrow's Tools-Today!

LANE WELLS COMPANY

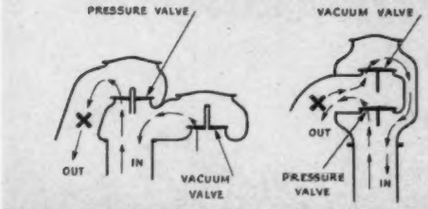
TECHNICAL OILFIELD SERVICES

General Offices and Export Offices
5610 South Soto Street • Los Angeles

24-HOUR SERVICE—30 BRANCHES

OCECO VENT VALVES

with *SEPARATE* pressure and vacuum openings



minimize *FLASH-BACK* hazard

● Laboratory tests and many tank fires have shown that when vapor passing outward through a vent valve becomes ignited—the flash (if no flame arrestor is used) can pass back into the tank if the velocity of the flash is greater than the velocity of the vapor flowing outward past the valve. The only positive protection against flash-back is an adequate flame arrestor . . . But if you don't use a flame arrestor be sure to specify an Oceco Vent Valve. It's the next best thing.

As shown by the diagram above, a flash of vapors leaving the tank at point marked X in Oceco's separate outlet valve, tends to close the pressure valve without opening the vacuum valve. In the combined outlet valve design, the flash has maximum opportunity to open the vacuum valve and find easy entrance into the tank.

Minimized flash-back is only one advantage of Oceco Vent Valves . . . Strong, fire resistant housings — positive venting at the desired pressure and vacuum — and large flow capacity are some of the others. You'll find full details in our recently completed Catalog V-50 . . . Send for a copy today!

OCECO

Division of

THE JOHNSTON AND JENNINGS COMPANY

891 Addison Rd. **Cleveland, Ohio**

CHEMICO

the leading name in acid plants

Chemico supremacy is based on 28 years of specialized experience in acid production and recovery, unequaled resources and facilities in experimentation and design, and the results obtained in hundreds of installations all over the world. Consult Chemico for either new construction or remodeling of acid plants, whether for large or small requirements.

Chemical Construction Corporation

30 Rockefeller Plaza, New York, N. Y.

Cables:—Chemiconst, New York

European Representatives, Cyanamid Products, Ltd., Berkhamsted, Herts., England

CHEMICO PLANTS are PROFITABLE INVESTMENTS

tities of naphthenic acids are frequently distilled in the presence of sodium hydroxide in order to improve the quality of distillate fractions and minimize corrosion of equipment. The sodium salts resulting from this treatment are concentrated in the residuum of the still, which is commonly referred to as "soda tar", increasing its ash content. However, soda tar having a high ash content is not satisfactory for use as a fuel because on burning it deposits an alkaline residue that has a deleterious action on conventional furnace refractories. Hence, the reduction of the ash content of the soda tar is of considerable economic importance.

Several methods were proposed for lowering the ash content of petroleum oils, such as washing with hot water under pressure, or treatment with acid and alcohol, but most of them are not commercially applicable because the use of aqueous reagents leads to formation of emulsions which are difficult to resolve. For this reason in the search for new methods capable of removing sodium from the still residue the use of water solutions in conventional plant equipment has not been considered desirable.

The authors have worked out a practical method which consists in treating the oils with boric acid at about 400° F. The acid is recovered from the resulting sludge by acidification with sulfuric acid or sulfuric acid sludge. The treated oils thus obtained are free from moisture and easily pass general specifications developed for industrial fuels.

Butadiene by the Houdry Dehydrogenation Process—C. H. Thayer, E. R. Lederer and R. C. Lassiat, in CHEMICAL & METALLURGICAL ENGINEERING, Vol. 49 (1942), No. 11, pp. 116-117.

This article deals with the Houdry two-stage dehydrogenation process for production of 15,000 tons of butadiene per year in each plant. This size of plant is admirably suited for small refineries and for natural gasoline and recycling plants where a sufficient supply of butane is available. It can also be erected in natural gas fields where butane is separated from natural gas and the rest piped away as fuel gas. The Sun Oil Company is building such a plant mostly out of existing or second-hand equipment; less than 20 percent of the total material except lumber and cement had to be brought under priorities.

Various advantages of the process in the present emergency are pointed out. For one thing, the process and plant design are such that operations can be begun in six months after ground is broken. After the war the plant can easily be converted for production of aviation gasoline. Furthermore, the use of butane does not reduce the amount of raw material needed for the 100-octane aviation gasoline, as would be the case if butylene were used as the feed stock. It is estimated that 44 plants of this type, charging in all about 30,000 bbl. of butane a day (the Bureau of Mines says that 175,000 bbl. a day are available) can produce 660,000 tons of butadiene annually or enough for 880,000 tons of rubber. It is said that this whole capacity could be put into operation in nine months.

The charging butane is subjected to dehydrogenating conditions in the reactors in two stages. The first stage yields butane, butylene and lighter gas. The butane and butylene portion is concentrated in a vapor recovery system to produce the charge for the second dehydrogenating stage in which butadiene is produced.

USES

Influence of Lubricating Oil Viscosity on Cylinder Wear—H. A. Everett, before SOCIETY AUTOMOTIVE ENGINEERS, Detroit Meeting, January, 1943.

From the author's results it appears that the cylinder and ring wear in well-lubricated engines decreases progressively with increasing viscosity throughout the range tested, the wear being almost inversely proportional to the kinematic viscosity. This is in harmony with our current understanding of fluid film lubrication as the film thickness for a given loading is probably nearly proportional to the kinematic viscosity and certainly wear is an inverse function of the film thickness. An accurate determination of the character of the lubrication, i.e., whether of fluid film or boundary type, can not be made but the small amount of wear, the smooth surfaces, and the light loading due to ring pressures indicate that through the majority of the reciprocating cycle fluid film action was predominant.

The tests were made on six single-cylinder operating under conditions simulating moderately heavy road operation of automobile passenger car engines.

BOOK

A.M.T.M. Standards on Petroleum Products and Lubricants—By A.S.T.M. Committee D-2; published October, 1942, by AMERICAN SOCIETY TESTING MATERIALS, Philadelphia, 442 pages, $2.25.

Since 1927, this manual of standard tests has become more and more comprehensive as the work of Committee D-2 progresses in the development of specifications and tests. This new edition includes some 87 standards; in addition there are several proposed tests covering the following: Oil content of paraffin wax, color of lubricating oil by means of photoelectric colorimeter, potential gum in aviation gasoline, and oxidation characteristics of heavy-duty crankcase oils. New standards given for the first time cover tests for neutralization number of petroleum products by color-indicator titration and by electrometric titration, test for rust-preventing characteristics of steam-turbine oil in the presence of water, conversion of kinematic viscosity to saybolt furol viscosity, and a test for sludge formation in mineral transformer oil.

Included among the widely used standard tests for petroleum products are the following: Acid heat (gasoline), aniline point, burning quality (kerosene, long-time burning, and mineral seal oil), carbon residue, cloud and pour points, consistency (greases and petrolatum), ductility (bituminous materials), flash points by open cup, Pensky-Martens and Tag-closed tester, gum content (gasoline), and knock characteristics (motor and aviation fuels), oxidation stability (gasoline), precipitation number, saponification number, sediment (fuel oil), tetraethyl lead (gasoline), thermal value (fuel oil), vapor pressure (motor, aviation, and natural gasoline), and water and sediment.

Specification requirements are given for cut-back asphalts (rapid-curing and medium-curing type), fuel oils, emulsified asphalts (four types), gasoline, petroleum spirits, stoddard solvent, and A.S.T.M. thermometers.

1942 INDEX AVAILABLE

A complete index of the editorial contents of World Petroleum for the year 1942 has been prepared and will be mailed to subscribers on application. To conserve paper no general distribution will be undertaken but copies will be gladly supplied to those in a position to make use of them.

GENERAL

Manufacture of Butadiene From Ethyl Alcohol—J. H. Gamma and T. Inouye, in CHEMICAL METALLURGICAL ENGINEERING, Vol. 49 (1942), No. 12, p. 97; vol. 50 (1943), No. 1, p. 94.

Starting from ethyl alcohol as the raw material, the manufacture of butadiene rubber is divided into three phases: (1) synthesis and purification of the butadiene, (2) polymerization of the butadiene, and (3) compounding of the butadiene polymer.

There are a number of ways by which butadiene can be produced from ethyl alcohol, depending upon the type and sequence of the reactions used and upon the intermediate compounds involved. A bird's eye view of the inter-relations that exist between the different methods that can be used and of the pathways that lead from ethyl alcohol to butadiene is given diagrammatically. (See figure.) In the present discussion, the methods for producing butadiene from ethyl alcohol are divided into six groups:

1. Direct conversion of ethyl alcohol.
2. The aldol method.
3. Ethylene methods.
4. Acetylene methods.
5. Acetaldehyde condensation.
6. Crotonaldehyde methods.

SPERRY-SUN

SPEED AND ACCURACY

always when you use

SPERRY-SUN

Throughout the world, over a period of years, Sperry-Sun Well Surveying Instruments and Technical Services have been among the producers' greatest aids in assuring fast, accurate and profitable drilling. Literature upon request.

SURWEL Clinograph
SYFO Clinograph
E-C Inclinometer
H-K Inclinometer
H-K Single Shot
M-M-O Bottom Hole Orientation
K-K Whipstock
Polar Core Orientation

SPERRY-SUN WELL SURVEYING CO.
PHILADELPHIA, PA.
HOUSTON, TEXAS LONG BEACH, CALIF.

STORAGE TANKS

any capacity

for OIL, PETROL, ETC.

ARC WELDED

We are experts in the designing, manufacture and erection of Welded Tanks.

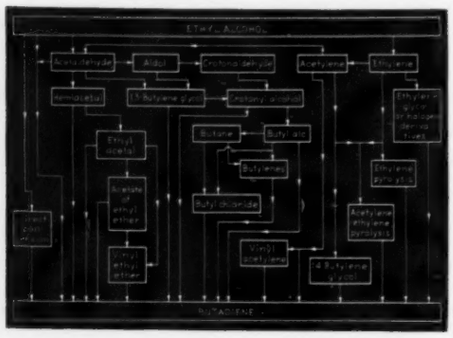
COMPLETE INSTALLATIONS

Send us your Enquiries

Oxley Engineering Co., Ltd.
HUNSLET LEEDS, 10 ENGLAND
Telephone LEEDS 27468/9 Telegrams: OXBROS LEEDS

LONDON OFFICE: Winchester House, Old Broad Street, E. C. 2
Telephone: LONDON WALL 3731

The direct conversion of alcohol to butadiene (1), consists of simultaneous dehydration and hydrogenation. This reaction was first developed in Russia by Lebedev (and is the basis of the method used in plants that are now producing butadiene for conversion into Buna S rubber). The Lebedev pro-



cess in its various modifications is based on the use of catalyzing chamber or converted tube which may be a foot or less in diameter and 12 feet long. This tube (of which there may be several) is set within a heating furnace fired by gaseous by-products. The alcohol is first vaporized, mixed with steam and air and preheated to about 450° C, which is about the same temperature as in the heating chamber enclosing the conversion tubes. The alcohol vapors are injected through a nozzle at the top of the conversion chamber, which is usually set in a vertical position and which is maintained at a temperature of 400-425° C. The vapors, as they traverse the length of the tube, are converted by a catalyst mixture of alumina and zinc oxide to butadiene and other products. These gaseous and volatilized reaction compounds are drawn from the conversion chamber and passed through a cooler which is maintained at 0° C, to condense the unconverted alcohol and other products condensable at this temperature. This condensation creates enough vacuum to draw the alcohol vapors through the converter at pressures slightly below atmospheric pressure, namely, at about 680-710 mm. mercury.

The reaction product is a complex mixture, containing a considerable proportion of butadiene and unchanged alcohol which is separated and recycled. The butadiene is separated as far as practicable by fractionation but for complete recovery it has to be washed out of the other vapors and gases by means of a solvent such as turpentine; an alternate method is to convert the butadiene into tetrabrombutone, which can easily be separated by distillation and reconverted into butadiene.

Power Alcohol: Its Advantages and Disadvantages.

—G. Narasimha Iyengar, in INDIAN SUGAR, Vol. 5, (1942), No. 7, pp. 288-292.

It is calculated that with legislation requiring motor fuel to be composed of 70 percent gasoline and 30 percent absolute alcohol all the surplus molasses produced in India could be utilized. Opponents of alcohol-gasoline fuel allege that the mixture is difficult to start, that the absolute alcohol is hygroscopic, and if moisture is absorbed the fuel will separate into two layers; that the cost of production is high, that adjustment of the carburetor is necessary, and that acid products of combustion corrode the engine. Advocates of the mixed fuel point out that addition of alcohol greatly increases the octane rating and anti-knock quality and that alcohol gives higher yields of power with lower consumption, especially with engines having high compression ratios.

GEOPHYSICS

OCTOBER, 1942

(Volume VII, Number 4)

The Value of Quantitative Interpretation of Gravity Data, ***D. C. Skeels***

A Mechanical Integrator for the Computation of Gravity Anomalies
Arnold J. F. Siegert

Local Areal Distribution of Velocities in the Texas Gulf Coast
B. G. Swan

An Analytical Method of Making Weathering Corrections
M. B. Dobrin

An Application of Seismic Surveying to the Location of Bauxite in Arkansas ***J. A. Gillin, Lorenz Shock and E. D. Alcock***

Note on the Transmission of Radio Waves Through the Earth
Daniel Silverman and David Sheffet

The Impedance of a Grounded Wire ***Alfred Wolf***

The business office of the Society of Exploration Geophysicists has been transferred to Washington, D. C. Correspondence relative to membership in the Society and to subscriptions to GEOPHYSICS should be addressed to the

SOCIETY OF EXPLORATION GEOPHYSICISTS

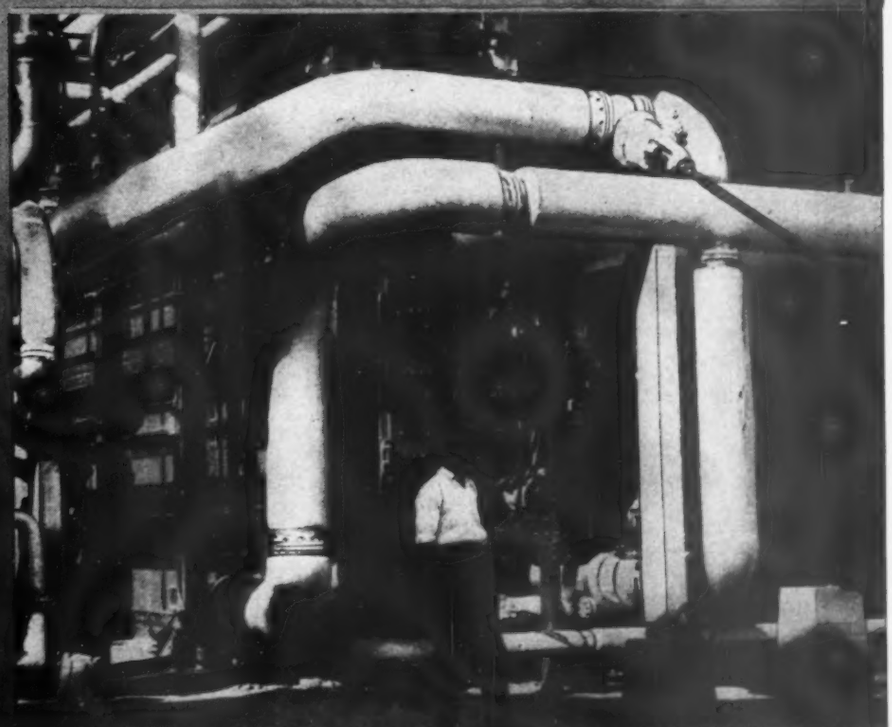
P. O. Box 1925 Washington, D. C.

NEWALLS

85% Magnesia Insulation

has been extensively used for the covering of pipe lines, heat exchangers, condensers, etc., for almost half a century. No insulating material comes nearer perfection. It has an extremely low thermal conductivity, is light in weight and will maintain its efficiency throughout the life of the plant.

The complete range of Newalls Heat Insulating materials is described in our 24 page booklet "HEAT INSULATION." May we send you a copy?



NEWALLS INSULATION CO. LTD. WASHINGTON STATION CO. DURHAM, ENGLAND

20-Inch Products Pipe Line Authorized

ACTING upon the recommendation of Petroleum Administrator Ickes and with the approval of its own advisory group the War Production Board on January 26 authorized the construction of a second war emergency pipe line. The new line is to extend from Houston and Beaumont, Texas to Seymour, Ind., a distance of 836 miles. It will be of 20-inch diameter and will be utilized for the movement of gasoline and other petroleum products. It will approximately parallel the 24-inch crude line recently completed from Texas to Illinois and now being extended to the Atlantic Coast.

The building of this 20-inch products line which is now to be undertaken under the stress of war demands is in substance a revival of a plan put forward in 1940 at which time a group of leading oil companies organized a company to construct a line from Texas to the eastern seaboard to be built by private capital. Inability to obtain allocation of the necessary materials from the SPAB predecessor of the War Production Board caused the project to be shelved. It was kept in view in the plans of the Office of Petroleum Administrator however and following the authorization the "Big Inch" crude line from Texas to Illinois and later on its eastward extension Secretary Ickes urged the War Production Board to approve the building of the second line.

As in the case of the War Emergency crude line the Board has confined its authorization to approximately half the entire project but if this can be carried through as scheduled it is expected that its extension to the Atlantic Coast area will be brought up for consideration and the Petroleum Administrator is reported to have notified the WPB that he would decide within the next few months whether to ask for the extension of this line to the East.

The new line will be built by War Emergency Pipe Lines, Inc., the organization headed by W. Alton Jones, president of Cities Service Oil Company, which is now completing the 24-inch crude line. It will be of similar construction and the section now approved will require approximately 164,000 tons of steel. It will be electrically operated and will require 55,000 horsepower to operate its pumping stations. Its capacity will be around 235,000 bbl. daily and it is expected to raise deliveries to the East by 110,000 bbl. daily through cutting down the length of tank car runs by something over 50 percent. The cost of the line is estimated at about $44,000,000.

While Seymour, Ind. is mentioned in the report as the eastern terminus of the new line it is possible that Norris City, Ill. may be substituted when final plans are drawn as it is pointed out that the storage facilities erected at the latter point for the 24-inch line will be available for the products line when it reaches Norris City and the "Big Inch" will have been pushed on eastward by that time. Construction of the new line is expected to start as soon as contracts can be placed and as soon as the materials section of WPB allocates the materials required. Completion of a number of other pipe line projects is expected to make available the crews and equipment needed for the work.

FILL WARTIME PETROLEUM NEEDS

with EASTERN EQUIPMENT

Eastern Mixers — the whole line — are on the job processing the nation's petroleum products.

In Gasoline Blending

★ A safer, more efficient fuel.

★ Faster output through thoroughness of blending.

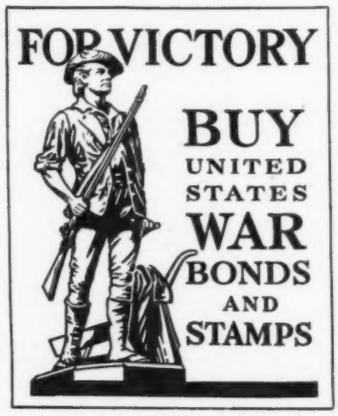
★ Savings—in power, less evaporation, and the cost of additional tanks.

In Synthetic Rubber Production

. . . Mixing is an important part of the process—from the first blending of the intermediates prior to polymerization down to the final mixing of the synthetic latex. Put Eastern Mixers on the job—this equipment has been tried and proved by many important producers.

Put Your Mixing Job Up To Eastern

Our experienced engineering staff stands ready to work out your problem. Write for information.

EASTERN ENGINEERING COMPANY

58 FOX ST., NEW HAVEN, CONN.